An intelligence diagnostic tool for the diagnostic of hypertension

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AN INTELLIGENCE DIAGNOSTIC TOOL FOR THE DIAGNOSTIC OF HYPERTENSION

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**A Thesis submitted to
the Nanyang Technological University
in partial fulfillment of the requirements for the degree of
Master's in Engineering (MEng) MAE**

2020

Statement of Originality

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The contributions of the co-authors are as follows:

- I and Dr Rajendra provided the initial project direction and edited the manuscript drafts.
- I and Ms Jahmunah prepared the manuscript drafts. The manuscript was revised by A/P Ng Yin Kwee Eddie and Dr. Tan Ru San.
- Ms Jahmunah contributed in providing information on hypertension
- Mr Simon Oh assisted in the collection of the results

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ABSTRACTS

Hypertension (HPY) commonly termed as high blood pressure is a severe health condition where long-term elevated pressure from the blood flow acting against the artery walls. The constant huge forces acting on the arteries wall causes the blood pressure to build up within the arteries, forcing the heart to work harder to deliver oxygen-rich blood from the heart to the other part of the human body. HPY is observed to be a risk factor for health conditions such as heart diseases, cerebrum diseases, and kidney failure, among others. The 24-hour ambulatory blood pressure monitoring (ABPM) is the current gold standard for detection and diagnostic for HPY.

White coat HPY and masked HPY (MHPY) are the two classes of HPY that are detected using ABPM. Patients with white coat HPY have an elevated clinical pressure of the blood while having a healthy pressure of the blood out of the clinical setting. Otherwise, in patients with MHPY, they are observed to have a healthy pressure of the blood in a clinical setting and an elevated pressure of the blood out of the clinical setting. Therefore, making it challenging to identify patients with MHPY, resulting in some remain not treated or not properly treated. Also, MHPY is identified as a class of high-risk blood pressure, which is linked with an elevated chance of developing heart-related complications and specific organ damage.

Thus, the diagnostic of MHPY is of specific attention in this research work. In MHPY, the on-the-spot blood pressure appears healthy, but the 24-hour ABPM is unhealthy. This causes patients with MHPY to be harder to be identified, with some undertreated or remain untreated. So, an intelligence diagnostic tool (IDT) incorporate with electrocardiograms (ECG) data for HPY and also MHPY diagnostic is proposed in this study. Two techniques will be used in this research work, the empirical mode decomposition (EMD) and a convolutional neural network (CNN) model.

EMD was introduced with the five-level of decomposition for the processed signals. Thereafter, the intrinsic mode functions (IMFs) are used to extract nonlinear features from the processed signals. Distinctly different nonlinear features are then captured after applying a two-tailed student statistical analysis to the nonlinear features. The selected nonlinear features are then fed to three different classifiers, whereas, the highest accuracy of 97.70% is yielded by the k-nearest neighbor (k-NN) classifier. The developed tool was validated using the 10-fold cross-validation technique, this is to ensure that the developed tool is accurate.

The processed signals were also fed into a CNN model. The CNN model will learn and identify the ECG signatures unique and classify the healthy and the HPY ECG signals. The 10-fold cross and leave one out patient based validation technique are used to evaluate the developed tool. The 10-fold cross-validation technique recorded an accuracy of 99.99%, sensitivity of 99.99%, specificity of 99.97%, and a positive prediction values of 99.99%, while for the leave one out patient based validation accuracy of 99.99%, sensitivity of 99.99%, specificity of 99.92% and a positive predictive value of 99.99%. Our findings suggest that the CNN model performed slightly better than the EMD technique. The developed systems are useful as an intelligence diagnostic tool in clinical application, which will allow the autonomous classification of HPY and healthy ECG signals.

Future research will study on classification of the ECG signal into the severity of hypertension, such as low-risk hypertension, and high-risk hypertension by using deep learning approaches. This is because the 24-hour ABPM and the current work done is only able to diagnose if the patient is healthy or having hypertension, and not the diagnosis of the risk factor of the possible onset of cardiovascular or cerebrovascular related disease.

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List of Abbreviations

ABPM	Ambulatory Blood Pressure Monitoring
ApEn	Approximate Entropy
AV	Atrioventricular
IDT	Intelligence Diagnostic Tool
CAD	Coronary Artery Disease
CNN	Convolutional Neural Network
CVD	Cardiovascular Disease
DT	Decision Tree
DWT	Discrete Wavelet Transformation
ECG	Electrocardiogram
EMD	Empirical Mode Decomposition
HDI	Hypertension Diagnosis Index
HDL	High Density Lipoproteins
HOS	High Order Spectrum
HPY	Hypertension
HR	Heart Rate
Hz	Hertz
IMFs	Intrinsic Mode Functions
KNN	K- Nearest Neighbour
LA:	Left Atrium
LDL	Low Density Lipoproteins
LV	Left Ventricle
LVH	Left Ventricle Hypertrophy
LOGE	Log and Energy

MATLAB	Matrix Laboratory
MHPY	Masked Hypertension
MIT-BIH	Massachusetts Institute of Technology-Beth Israel Hospital
ML	Machine Learning
mmHg	Millimetres of Mercury
OWFB	Optimal Orthogonal Wavelet Filter Back
P-Value	Probability Value
RA	Right Atrium
RP	Recurrence Plot
RQA	Recurrence Quantification Analysis
RV	Right Ventricle
SA	Sinoatrial
SampEn	Sample Entropy
SFD	Signal Fractional Dimensional
SHAREE	Smart Health for Assessing the Risk of Events via ECG
TIA	Transient Ischemic Attack
VLDL	Very Low-Density Lipoprotein
WHO	World Health Organisation

List of Symbols

α	Step function
α_i	Probabilities
ApEn	Approximate entropy
C_1^x	1 st order cumulant
C_2^x	2 nd order cumulant
C_3^x	3 rd order cumulant
C_4^x	4 th order cumulant
$C_m(r, N_m)$	Probability of two points on the orbit are closer together than r
$E[.]$	Expectation operator
E_f^x	Fuzzy entropy
E_j^r	Modified Multiscale entropy
E_{ks}^x	Kolmogorov Sinai entropy
E_p^x	Permutation entropy
E_r^x	Renyi entropy
E_{sh}^x	Shannon entropy
E_{ts}^x	Tsallis entropy
E_w^x	Wavelet entropy
m_1^x	1 st order moment
m_2^x	2 nd order moment
m_3^x	3 rd order moment
m_4^x	4 th order moment
$P(f)$	Power spectrum

R_f

Relative frequency

SampEn

Sample entropy

T

Sample period

$V = (x, y, m, N)$

Denotes fuzzy variable parameters

x

Length of a sequence

Chapter One: INTRODUCTION

1.1. Background

Hypertension (HPY) commonly termed as high blood pressure is a severe health condition where long-term elevation in pressure from the blood flow acts against the artery walls [1]. The consistent elevation in the pressure of the blood is due to the heart needing to pump with greater effort to deliver oxygen-rich blood from the heart to other parts of the human body [1]. HPY increases the risk and may lead to health problems such as heart diseases, strokes, kidney disease, vision loss, among many others [2].

According to a fact sheet published on 13 September 2019 by the Whole Health Organization (WHO), HPY caused an estimated 12.8% of total death amounting to 7.5 million death globally. HPY is one of the main factors which increases the risk of coronary heart disease and both hemorrhagic and ischemic stroke. The blood pressure level is linked negatively with the increased risk of cerebrovascular accidents and cardiovascular diseases. The risk of getting cardiovascular disease can double with an increment of blood pressure by 20 millimeters of mercury for systolic pressure and 10 millimeters of mercury for diastolic pressure for some age group, it can increase from as low as 115 millimeters of mercury for systolic pressure and 75 millimeters of mercury for diastolic pressure [3]

Equally important, WHO has reported that in the year 2015, 1.13 billion people are afflicted with HPY globally with 1 in 4 men and 1 in 5 women diagnosed with HPY [3]. While most people who are affected by the high pressure of the blood may show no signs or symptoms of HPY, some people who are affected by HPY will show signs of headaches, shortness of breath, dizziness, nosebleed, vision change, or syncope [4]. Hypertension can be separated into healthy, pre-hypertensive, and hypertensive stages [5].

According to the National Heart Centre Singapore (NHCS) shown in *Table 1*, healthy systolic pressure should be lower than 130 millimeters of mercury and a healthy diastolic pressure should be lower than 80 millimeters of mercury. The pre-hypertension blood pressure ranges from 130 to 139 millimeters of mercury for systolic pressure and 80 to 89 millimeters of mercury for diastolic pressure, and for HPY blood pressure is above 140 millimeters of mercury for systolic pressure and above 90 millimeters of mercury for diastolic pressure [6].

The current benchmark for diagnosing HPY is the 24-hour ABPM method [7]. ABPM is used to diagnose two types of HPY, namely the white coat and masked HPY. Patients with white-coat HPY are observed to have an elevated clinical pressure of the blood while having a healthy pressure of the blood out of the clinical setting. Otherwise, in patients with MHPY, they are observed to have a healthy pressure of the blood in a clinical setting and an elevated pressure of the blood out of the clinical setting [8]. This causes patients with MHPY to be harder to be identified, with some undertreated or remain untreated [9]. This is worrisome, as MHPY is deemed as a perilous pressure of the blood condition, that is conjoined with an elevated risk of heart-related complication and targeted organ failure [10,11,12,13].

Blood pressure or pressure of the blood is defined as the volume of blood circulated by the heart and the resistance to the blood flow in the arteries. Pressure in the blood varies from person to person, and it may also vary for the same individual over time [3,21,22].

The pressure of the blood is measured in millimeters of mercury and is written as a fraction of systolic pressure against diastolic pressure. Systolic pressure is the measurement of the pressure needed for the heart to contract and pump the blood to other parts of the body, while diastolic pressure is the measurement of pressure in the heart when it relaxes and blood filling the open chambers [3,21,22].

The harder the heart needs to pump the blood around the body, the higher the pressure of the blood is. HPY usually develops over many years, mainly due to unhealthy diets and lifestyle, with a small percentage due to specific illnesses [3,21,22].

Figure 1(a) and (b) represent respectively the healthy ECG signal and HPY ECG signal. Figure 10 and Figure 11 record the proposed methods used in this study. Table 6 shows other authors' work using IDT coupled with the use of ECG data for the detection of HPY.

Figure 1: (a) Healthy compared to (b) HPY ECG signals.

Table 1: Ranges of blood pressures.

Classification	Systolic (mm Hg)	Diastolic (mm Hg)
Normal	< 130	< 80
Pre-hypertensive	130-139	80-89
Hypertensive	≥ 140	≥ 90

1.7. Objective and Scopes

Biological waves are nonlinear and ever-changing exhibiting small-signal peaks and short period, intra-observer, and inter-observer inconsistency can happen during clinical explicate by medical professionals. Therefore, to improve on these disadvantages, an intelligence diagnostic tool (IDT), used in the diagnosis of HPY using ECG data is proposed in this study.

The objectives of this research work is to develop the proposed methodology that can accurate, more robust, and cost effectively diagnose and analyze ECG morphology that has the potential to be used to identify HPY for situations when the on-the-spot blood pressure is observed to be healthy such as that of MHPY. This distinguishes our study from the others, making it novel. Therefore, minimizing the possible human errors and helps to get accurate results always.

This methodology aims to attain the following scopes:

1. To provide automated diagnostic of HPY
2. To standardize the size of the samples before classification
3. To implement non-linear method of analysis
4. To classify ECG using machines learning and neural networking techniques for classification

Chapter Two: Literature Review

2.1. How does hypertension (HPY) occur

HPY occurs when the arterioles (smaller blood vessels) get narrowed, causing the heart to pump harder to deliver oxygenated blood to the capillaries and other parts of the human body. This causes the blood to be constantly exerting excessive pressure against the blood vessel walls. Despite the ability of the heart and the blood vessels to get adapted to the elevated pressure of the blood, a prolonged period will cause the enlargement of the cardiovascular muscles called hypertrophy. This could eventually wane the cardiovascular muscles and may result in possible cardiovascular failure [25]. Figure 2 illustrates that when the arteries get narrowed, the path where the blood travels will be reduced. Hence, resulting in the amount of blood flow to be limited causing the heart having to pump harder to allow more oxygenated blood to flow to the other parts of the body.

Figure 2: Illustration of a normal artery verse a narrowed artery [27].

HPY can occur in two forms, essential HYP or secondary HYP. Essential HYP is also called idiopathic or primary HYP, there is no noticeable underlying cause for essential HYP. Hence, making essential HYP difficult to treat. 90 to 95 percent of HYP patients fall in the essential HYP category, making it the most common type of high blood pressure. Inheritance factor constitutes a major part of the development of essential HYP in most patients [25].

Secondary HYP is often correlated to an underlying disease and could originate from a renal, neurological, or endocrine-related disease, examples of such diseases include glomerulonephritis, inflammation of urinary tract structures in the kidney, atherosclerosis of blood vessels in the cerebrum, and hyperactivity of the adrenal glands. Unlike essential HYP, treating the correlated underlying disease may cure the high blood pressure [25].

2.2. Risk factors for hypertension patient

HYP patient has the risk of damages to the arteries, cerebrum, kidney, and heart. Arteries become damaged and get narrowed due to the damaging of the cell of the inner lining of the arteries. Lipids start collecting in the damaged arteries because of an unhealthy diet, the artery walls eventually become less flexible and blood flow through the body becomes limited. Another risk related to the arteries is an aneurysm, the enlargement of a section of the weakened artery wall forming a bulge. An aneurysm can be life-threatening if it ruptures and causes internal bleeding. Although the formation of aneurysms can occur at any artery, but it occurs more often in the aorta [41].

The cerebrum requires oxygenated blood supply to be functional, but HYP can cause disruption to the blood flow due to the damage of the arteries, increasing the risk to disease that damages the cerebrum. Transient ischemic attack (TIA) also known as mild stroke, is a short-term disruption to the blood flow to the cerebrum caused by arteries that have hardened or blood clots due to HYP. TIA is often a symptom of a possible risk of a full-blown stroke. A full-blown stroke occurs when

cerebrum cells die because part of the cerebrum was deprived of oxygen and nutrients, this is due to the rupture or leakage of blood vessels leading to the cerebrum [41].

The kidneys help to remove excess fluid and metabolic waste from the blood, and this process requires healthy blood vessels to be functional. Glomerulosclerosis (kidney scarring) occurs when small blood vessels within the kidney become damaged, leading to kidney failure. HPY is the number one reason for kidney failure, as the damaged blood vessels cause the kidney to be inefficient in removing excess fluid and metabolic waste resulting in a dangerous level of fluid and metabolic waste accumulation [41].

The blood flow is centralized around the heart, and HPY damages the blood vessels and thus, the blood flow is the main cause of many heart diseases. Coronary artery disease (CAD) is caused by a reduction in cross-section or damaging of blood vessels due to HPY, resulting in disruption to the blood flow to the cardiovascular muscles. Angina, arrhythmias, and myocardial infarction (MI, heart attack) are symptoms of CAD. Left ventricle hypertrophy (LVH) is the effect of HPY forcing the heart to pump harder to circulate blood to the rest of the body, resulting in thickening of part of the left heart. LVH increases the risk of myocardium infarction (MI), heart failure, and sudden cardiac arrest [41].

Coronary artery disease (CAD) occurs when plaques are deposited in the coronary arteries, causing the narrowing or blockage of coronary arteries which deliver oxygen-rich blood to the human heart. Plaque is usually made up of lipids, cholesterol, calcium, cellular waste, and fibrin. The narrowing or blockage of coronary arteries reduces the oxygen-rich blood received by the heart; this causes the heart to malfunction due to being deprived of oxygen [41,42,43].

Angina also is known as chest pain often develops due to the reduction of oxygen to part of the heart. Angina is discomfort that feels like pressuring or squeezing of the chest which can feel like indigestion. In a serious case of total blockage of oxygen to part of the heart, MI also known as a

heart attack will occur. During a heart attack if the oxygen-rich blood flow to the heart is not restored quickly it will result in death to parts of the heart muscle, death of heart muscle will cause many health complications [41,42,43].

Myocardial infarction (MI) is a life-threatening medical condition, also known as heart attack which occurs when the flow of oxygenated blood to the myocardium is suddenly cut off causing myocardium tissue to be damaged. Myocardial infarction is the irreversible and silent damage of the myocardium tissues. Myocardial infarction usually occurs due to the blockage of one or more of the coronary arteries supplying blood to the myocardium. The blockage of the coronary arteries can occur due to the build-up of plaque which is made up mainly by fats, cholesterol, and cellular waste products [41,42,43].

2.3. The biology of the heart

The human heart weighs on average 300 grams, and is roughly the size of a clenched fist of an adult human Figure 3 represents the morphology of the heart, which is split into the systemic (left heart) and pulmonary circuit (right heart) and is made up of 4 chambers and 4 valves. The systemic circuit consists of the left atrium (LA), left ventricle (LV), aortic valve, mitral valve, while the pulmonary circuit consists of the right atrium (RA), right ventricle (RV), tricuspid valve and pulmonary valve [44,49,55].

Electrocardiogram (ECG) signal is the reading taken from the electrical activities of the cardiac muscles and consists of the P, QRS, T waveforms. Figure 4, shows the conduction system of the heart where the reading of the ECG signal is generated: 1) when the pacemaker of the heart, the sinoatrial (SA) node generates potential difference also called impulses. 2) The generated impulses travel across the heart via a nodal tissue pathway, that is conducted by the left and right atria causing contraction of the atriums. The contraction of the left atrium and right atrium is recorded as the P wave on the ECG reading [44,49]. 3) After passing across the left and right atrium, the potential difference will travel to the atrioventricular (AV) node, where there will be

100 milliseconds delay to allow the left and right ventricles to be filled with blood. 4) After the blood fills the left and right ventricles, both ventricles will contract due to the impulses traveling to and spread through the Purkinje fibers. 5) The contractions of the left and right ventricles are recorded as the QRS waveform on the ECG reading. And lastly, the relaxation of the ventricles is recorded as the T waveform on the ECG reading [44,49,54].

Figure 5 shows how a healthy ECG signal looks like. The PR interval is the time representation from the start of atrial contraction and the start of the ventricular contraction. The QRS interval is the time representation of the duration of the ventricular contraction. The QT interval is the time representation between the start of the ventricular contraction and ventricular relaxation. The ST segment is time representation from the completion of ventricular contraction and the start of ventricular relaxation [46].

Figure 3: Anatomy of the heart. Consist of the left atrium, right atrium, left ventricle, right ventricle, tricuspid valve, pulmonary valve, mitral valve, and aortic valve [61].

Figure 4: Conduction system of the heart [61].

Figure 5: Healthy ECG signal [46].

2.4. Left ventricle hypertrophy (LVH)

Left ventricle hypertrophy (LVH) is a medical condition where the left ventricle muscle wall enlarged and thickened, resulting in the heart not pumping efficiently. The enlargement and thickening of the LV wall are the response from the heart muscle cells for a prolonged period of high pressure in the blood. This causes the left ventricle to weaken, become stiffer, and loses its elasticity and disrupt the proper blood flow [50,51,52].

LVH is a common symptom of HPY, that unfortunately is not an ideal development for HPY patients. It is a sign of evolving fatal atherosclerotic disease also known as coronary artery disease (CAD), which is the formation of plaque in the oxygen-rich arteries. LVH is when the heart muscle (myocardium) is hypertrophied, and due to the larger mass of myocardium for electrical signals gets activated. Thus, shown in Figure 6 that the LVH QRS interval as compared to a healthy QRS interval will increase in amplitude. [46,50,51,52].

Figure 6 also indicates that the ECG signals captured using V1 and V2 will look similar, and the ECG signals captured using V5 and V6 will look similar [51,52]. In Figure 7 it shows the placement of the ECG leads during an ECG test, where V1 is placed at the fourth intercostal space on the right side of the rib cage, V2 is placed on the fourth intercostal space on the left side of the rib cage, V3 is placed in between and V4, V4, V5, and V6 are placed on the fifth intercostal space on the mid-clavicular, anterior axillary, and mid-axillary respectively [52,54].

Figure 6: Healthy VS LVH QRS complex (ECG signals captured using V1 and V2 leads will look identical, and ECG signals captured using V5 and V6 leads will look identical [46].

Figure 7: ECG leads placement during an ECG procedure.

HPY patient has a threefold increase in risk for the development of CVD as compared to a normotensive person of the same age. HPY has increasingly been associated with other health conditions such hyperlipidemia which is having too many lipids such as cholesterol in the blood, hyperglycemia which is having high blood sugar level, hyperuricemia which is having a high level of urine acid in the blood, excessive weight, and unhealthy ECG [50,51,52].

2.5. Diagnosis method for hypertension (HPY)

Traditionally the mercury sphygmomanometer is used to measure the pressure of the blood. Figure 8 shows that the mercury sphygmomanometer is made up of an inflatable pressure cuff, a bulb that is used to inflate the pressure cuff, a measurement indicator mercury-filled tube. The inflatable pressure cuff is wrapped around the patient's upper arm, and the bulb will inflate the pressure cuff till the mercury indicator shows 180 mmHg, the stethoscope will be placed at the artery and air will be slowly released from the pressure cuff. The first sound heard in the stethoscope indicates the systolic pressure, when the sound stops it indicates the diastolic pressure and the reading could be taken by observing the indicator on the mercury tube [53].

Figure 8: Illustration of a mercury sphygmomanometer[53].

The current gold standard for diagnosing HPY is the 24-hour ambulatory blood pressure monitoring (ABPM) method, it is a non-invasive process done manually or by an automated sphygmomanometer (blood pressure cuff). Figure 9 shows how the monitoring device is attached to the patient, while they go on with their daily activities. The small monitoring device is commonly attached to the waist of the patient, with a connected cuff around the patient's upper arm. The device is made up of a gauge and an inflatable rubber cuff that will be placed around the arm during the blood pressure test, which will only take a couple of minutes [45,47,49,59]. ABPM is used to diagnose two types of HPY, namely the white coat and masked HPY. Patients with white coat HPY are observed to have an elevated clinical pressure of the blood while having a healthy pressure of the blood out of the clinical setting. Otherwise, in patients with MHPY, they are observed to have a healthy pressure of the blood in a clinical setting and an elevated pressure of the blood out of the clinical setting [45]. This causes patients with MHPY to be harder to be identified, with some undertreated or remain untreated [47]. This is worrisome, as MHPY is deemed as a perilous blood pressure classification, that is linked to an increase in the risk of heart-related diseases and specific organ damage [45,47,49, 59].

Figure 9: Illustrate the wearing of the 24-hour blood pressure monitoring device [48].

Other tests could also be ordered by the doctors to identify the possible cause of HPY and to assess if any of the organs are damaged due to the constant high blood pressures or its treatment. These tests include blood tests, lipid profile tests, urine tests, eye examination, ultrasound tests, electrocardiograms (ECG), and echocardiograms [45,47,49, 59].

Blood tests are used to assess the kidney activities, such includes the measurement of electrolytes, blood urea nitrogen, and creatinine levels. Lipid profiling test helps to measure the cholesterol levels of various kind of cholesterol, namely the low-density lipoproteins (LDL), high-density lipoproteins (HDL), and very-low-density lipoproteins (VLDL). Urine tests are for the measurement of healthicity in hormones and electrolytes levels. As the blood vessels in the eyes are small and burst easily with higher pressure from the blood flow, a non-invasive will be ordered to check for ocular damages due to constant build-up of the pressure of the blood. Ultrasound scan is one of the most commonly ordered examinations, as ultrasound scans allow the doctors to check for symptoms such as kidney enlargement or damages [45,47,49, 59].

ECG test is a non-invasive procedure that helps to evaluate the possible damages to the cardiac muscles, and identifying the existing and onset of CADs. An echocardiogram is a specific ultrasound scan of the heart that allows real-time visualization of the motion of the heart. It can capture many heart issues such as left ventricular hypertrophy, thickening of heart walls, blood clots, and abnormal healthicties heart valves [45,47,49, 59].

However, most of the above-mentioned procedures are two-step processes and are time, cost, and manpower consuming. ECG test is the only one-step process, that allows the detection of HPY through the changes or abnormal healthicties in electrical activities of the heart, as well as the detection of existing or onset of CADs. Hence, automation of the analysis of ECG to detect HPY helps to reduce the time consumed, manual interpretation of results, and most importantly helps to reduce the errors in diagnosis [45,47,49, 59].

Chapter Three: METHODS

Figure 10: Flow diagram of IDT using EMD to detect HPY.

Figure 11: Flow diagram of the IDT CNN model to detect HPY.

3.1. Data used

The raw ECG data are downloaded from Physionet, an open-source ECG database that has been commonly used for research purposes. A total of 18 raw healthy ECG signals are recorded in the Massachusetts Institute of Technology-Beth Israel Hospital (MIT-BIH) healthy sinus rhythm database, and all 18 of the ECG signals are used in our work [36]. A total of 139 raw hypertension ECG signals are recorded in the Smart Health for Assessing the Risk of Events via ECG (SHAREE) database, and all 139 ECG signals are used in our work [37]. The 139 HPY ECG data that was acquired contains 49 females and 90 males with the age above 55 years. After a wash out period for the HPY drugs, a twenty-four-hour Holter device is hooked on to the patients to record the ECG signals of the patients over a period of one month. The recording is made up of 3 ECG data set captured at 128Hz with 8-bit precision of a 24 hours duration. The single ECG lead (III) data with an inconsistent number of segmentations were acquired from the device [37].

Figure 10 details the methodology used with the EMD technique. Firstly, the downloaded raw ECG signals will be processed for segmentation and denoising. Denoising is the removal of interference of various noises such as power line interference and baseline drift. The processed ECG signals will then be decomposed into five levels by using empirical mode decomposition. Nonlinear features will be extracted from the decomposed ECG signals. The extracted features will go through the T-test for the selection of the most distinctive features ($P \leq 0.05$). The selected features will be used to classify the ECG signals into healthy or HPY class.

Figure 11 details the methodology used with the CNN technique. Firstly, the downloaded raw ECG signals will be processed for segmentation and denoising. The processed ECG signals will then be feed into the CNN model, the CNN model will then learn and identify the ECG signatures unique and classify the healthy and the HPY ECG signals.

3.2. Data processing

Matlab software was used to pre-process the healthy and HPY ECG signals that were acquired. The 18 healthy ECG recordings were segmented into 9000 segments, while the 139 HPY ECGs were segmented into 69500 segments. For easier comparison, each segment is consisting of 2000 samples. The healthy and HPY ECG signals that were acquired were both sampled at 128Hz; hence, no re-sampling of the ECG signals was necessary. Thereafter, discrete wavelet transformation (DWT) was used to denoise the ECG data [38].

3.3. Nonlinear methods of analysis

Empirical mode decomposition (EMD) is then introduced for the decomposition of the processed ECG data. EMD is frequently utilized to extrapolate nonlinear features for the classification of cardiovascular-related medical conditions [60,61] Figures 5a and 5b present the five-level of decomposition of the healthy and HPY ECG signals. In EMD, intrinsic mode function (IMFs) is the conversion of complexed data to a fixed value data point with varying frequencies. This is a repetitive sifting process, that continues until it satisfies the criteria of the number of extrema is no more than or equal to two. EMD is commonly used to extrapolate oscillations of high-frequency from the initial data [61]. Two criteria must be conformed by every IMF [61,62]:

1. All zero crossings or extrema either has to be equal or differ by at most once in the dataset,
2. At any point, the mean value of the envelopes defined by the local minima and maxima has to be zero.

In this research work, five IMFs were used to decompose the ECG data. ECG signals are nonlinear and chaotic by nature, therefore, nonlinear features were used to study the bio-signals[63]. Thus, the extraction of thirteen nonlinear features was subsequently employed from the IMFs and is explained in chapter 2.3.2 to chapter 2.3.14 of this thesis. To record a set of distinctly different nonlinear features, two-tailed student statistical analysis was then utilized and nonlinear features that achieve a probability value lower than 0.05 were selected.

Figure 12: Images of 5 levels of IMFs using EMD (a) healthy and (b) HPY ECG signals.

3.3.1. Empirical Mode Decomposition (EMD)

The Empirical Mode Decomposition (EMD) is a straightforward, flexible, and data-dependent nonlinear analysis method for bio-signals. It will always assume nonlinearity and nonstationary conditions for bio-signals. All complicated bio-signals will be broken down into a classification of Intrinsic Mode Function (IMFs), which are local time and scale based AM and FM modulated waveforms of the bio-signal [61,62].

3.3.2. Recurrence Quantification Analysis (RQA)

The recurrence plot (RP) is able to show at any given point of time, the times the phase space paths coincide with the same location in the phase space. The dynamical system of the RP is estimated by using the RQA method and provides the numbers of recurrences as well as the duration of each recurrence, which measures the non-stationary and subtle rhythm changes in the HR signals [64].

3.3.3. Higher-Order Spectrum (HOS) Bispectrum

Higher-Order Spectrum (HOS) is a method used to study the non-Gaussian and non-stationary biological energy. HOS help to identify the diversions of the frequency component of the bio-signals from Gaussian and phase correlations. The advantage of using HOS is that it is less prone to interferences and maintains the original phase data in the bio-signals [65]. Fourier transform of the 3rd order correlation of bio-signals is given by:

HOS is calculated by:

Bispectrum: $B(f_1, f_2)$

$$B(f_1, f_2) = E[X(f_1)X(f_2)X(f_1 + f_2)] \quad (1)$$

$X(f)$ – Fourier transfer of input $X(nT)$

n – variable

T – Sample period

$E[.]$ – Expectation operator

Healthyized Bispectrum: $B_{norm}(f_1, f_2)$

$$B_{norm}(f_1, f_2) = \frac{E[X(f_1)X(f_2)X(f_1+f_2)]}{\sqrt{E[P(f_1)P(f_2)P(f_1+f_2)]}} \quad (2)$$

$P(f)$ – Power spectrum

3.3.4. High Order Spectrum (HOS) cumulant

Using the 1st and 2nd order of statistics to analyze nonlinear and nonstationary bio-signals are challenging. Hence, 3rd order cumulant which is 3rd order correlation derived from the HOS cumulant is used for bio-signals. Cumulant computation has been successfully used in differentiating of automatically control, and nonstationary bio-signals [66].

Cumulant computation is calculated by:

Let $\{x_1, x_2, x_3, \dots, x_k\}$ indicates a k dimensional random process of 0 mean values.

$$m_1^x = E[x(n)] \quad (3)$$

$$m_2^x(i) = E[x(n)x(n+i)] \quad (4)$$

$$m_3^x(i, j) = E[x(n)x(n+i)x(n+j)] \quad (5)$$

$$m_4^x(i, j, k) = E[x(n)x(n+i)x(n+j)x(n+k)] \quad (6)$$

m_1^x – 1st order moment

m_2^x – 2nd order moment

m_3^x – 3rd order moment

m_4^x – 4th order moment

i, j – time lag parameters

Cumulants evaluated using moment:

$$C_1^x = m_1^x \quad (7)$$

$$C_2^x = m_2^x(i) \quad (8)$$

$$C_3^x = m_3^x(i, j) \quad (9)$$

$$C_4^x = m_4^x(i, j, k) - m_2^x(i)m_2^x(j-k) - m_2^x(k-i) - m_2^x(k)m_2^x(i-j) \quad (10)$$

C_1^x – 1st order cumulant

C_2^x – 2nd order cumulant

C_3^x – 3rd order cumulant

C_4^x – 4th order cumulant

3.3.5. Approximate Entropy (ApEn)

Approximate entropy (ApEn) represents the alternation of HR in the period frequency and is often used to measure and distinguish if the recorded bio-signals are stationary or nonstationary. The importance of ApEn is the ability of the parameters to detect the subtle changes in the episodic behavior of the bio-signals not reflected in the peak or amplitude occurrences [67].

A healthy subject's bio-signals are constantly fluctuating and nonstationary, which will be denoted by a higher value of ApEn. For subjects with cardiac disease, the bio-signals are regular and stationary, which is denoted by a lower value of ApEn [67].

ApEn is calculated by:

$$\text{ApEn}(m, r, N) = \frac{1}{N-m+1} \sum_{i=1}^{N-m+1} \log C_i^m(r) - \frac{1}{N-m} \sum_{i=1}^{N-m} \log C_i^{m+1}(r) \quad (11)$$

where

$$C_i^m(r) = \frac{1}{N-m+1} \alpha(r - \|x_i - x_j\|) \quad (12)$$

N – the amount of points in the phase space

r – radial length of a circular disk centered at the reference point $x_i - x_j$

α – step function

3.3.6. Sample Entropy (SampEn)

Sample entropy (SampEn) quantifies how complex a bio-signal is, which is very similar to the measurement of ApEn. SampEn measurements provide an improved and better method for understanding the time-series changes and is a useful tool for the studies of the dynamics of subjects with cardiac disease, as compared to ApEn. Unlike the ApEn measurement that compares itself with the other vectors, SampEn removes the comparison it has with itself. This is better as a comparison of itself to the other vectors will cause the value of ApEn to be lowered, hence, interpreted to be more stationary and regular than it is [68].

SampEn is calculated by:

$$C_i^m(r) = \{the\ number\ of\ j, j \neq i, j \leq N - m + 1, such\ that\ d[u(i), u(j)] \leq r\} / (N - m + 1) \quad (13)$$

Now we can determine:

$$\phi^m(r) = (N - m + 1)^{-1} \sum_{i=1}^{N-m+1} C_i^m(r) \quad (14)$$

And finally:

$$SampEn(m, r, N) = -\ln \frac{\phi^m(r)}{\phi^{m+1}(r)} \quad (15)$$

3.3.7. Fuzzy Entropy

Fuzzy entropy is used to measure the unpredictability of an ECG signal and is calculated by [69]:

$$E_f^x(V) = \int_{-\infty}^{\infty} R(K_r\{V \geq t\})dt \quad (16)$$

$V = (x, y, m, N)$ – denotes fuzzy variable parameters

x – length of a sequence

y, m – gradient and width exponential functions

N – length of a signal

3.3.8. Kolmogorov Sinai Entropy

Kolmogorov Sinai entropy is used to quantify the uncertainty over time for an ECG signal and is calculated by [70]:

$$E_{ks}^x = \lim_{r \rightarrow 0} \lim_{m \rightarrow \infty} \frac{1}{\tau} \frac{C_m(r, N_m)}{C_{m+1}(r, N_{m+1})} \quad (17)$$

$C_m(r, N_m)$ – probability of two points on the orbit is closer together than r

3.3.9. Modified Multiscale Entropy

Modified multiscale entropy is utilized to measure the intricacy of an ECG signal in the time series, and is calculated by [71]:

$$E_j^\tau = \frac{1}{\tau} \sum_{i=j}^{j+\tau-1} x_i \quad (18)$$

3.3.10. Permutation Entropy

Permutation entropy is used to estimate intricacy within an ECG data by calculating the couplings between signals [72]:

$$E_p^x = - \sum_{f=1}^n R_f \log_2 R_f \quad (19)$$

R_f – relative frequency

3.3.11. Shannon Entropy

Shannon entropy is used to measure and quantify the spectral intricacy of an ECG signal and is calculated by [73]:

$$E_{sh}^x = - \sum_{i=0}^{L-1} a_i \log_2(a_i) \quad (20)$$

3.3.12. Renyi Entropy

Renyi entropy is the generalized form like the Shannon entropy measuring the spectral intricacy and is calculated by [74]:

$$E_r^x(a) = - \frac{a}{1-a} \sum \log sp_i^a \quad (21)$$

3.3.13. Tsallis Entropy

Tsallis entropy is utilized to determine the sudden shift and long-term memory effects of ECG data and is calculated by [75]:

$$E_{ts}^x = \frac{1}{q-1} (1 - \sum_{i=1}^w \alpha_i^q) \quad (22)$$

q – non-extensivity

α_i – probabilities

3.3.14. Wavelet Entropy

Wavelet entropy is used to measure the degree of disorder and the relative energies in different frequency bands of an ECG signal and is calculated by [94]:

$$E_w^x = - \sum_{i < 0} \alpha_i \ln \alpha_i \quad (23)$$

α_i – probabilities

i – resolution levels

3.4. Classification

The distinctive nonlinear features were then feed to three classifiers, namely the decision tree (DT) [76], k-nearest neighbor (k-NN) [77], and linear discriminant analysis(LDA) [80].

The decision tree has a structure corresponding to a tree constructed by tree nodes which represent testing, k-NN which functions by classifying the nonlinear feature specifically to the data points that is most prominent around the k-nearest neighbors, and LDA studies the results by the probability of the new data points belonging to which of the two classes, wherein the class that the new data point has the highest probability to fall under is the output [76,77,80].

In this study, 10-fold cross-validation [78] is deployed to train and test the data. The ECG data will be split into 10 equal data sets with 1 data set used for testing while the remaining 9 data set is used for training. As illustrated in Figure 13 the first fold of validation the data set that contains the first 10% of the ECG data will be used for testing, while the remaining 90% of the ECG data will be used for training. In the second fold of validation, the second data set which contains the 11% to 20% ECG data will be used for testing while the remaining data is used for training. This process will repeat till the tenth fold of validation, where the last data set that contains the 91% to 100% of the ECG data will be used for testing while the remaining data is used for training.

First, “training” will be conducted for the classifier to differentiate the unique ECG morphology of both the healthy ECG and HPY ECG signals. By “training” the classifier to differentiate the unique ECG morphology of the two classes of ECG data, the classifier will be capable of accurately and effectively classify any healthy or HPY ECG signal feed to it.

Secondly, “testing” is conducted to ensure that the classifier is performing according to the requirement. Multiple healthy ECG and HPY ECG signals will be fed to the classifier to differentiate and separate the data into healthy ECG and HPY ECG signals.

Figure 13: 10-Fold cross-validation technique.

3.4.1. Decision Tree (DT) Classifier

The decision tree classifier is a supervised machine learning algorithm that continuously divides the data according to a specific parameter. *Figure 14* shows a downstream flow chart, where every node represents a test on an attribute parameter, and each branch leads to an outcome of the test, and each leaf is a classification of the different distribution [76].

Figure 14: Decision Tree classifier [76].

3.4.2. k-Nearest Neighbor (k-NN) Classifier

The k-nearest neighbor classifier is an instantaneous, simple, easy to understand machine learning algorithm that is non-assumption-based sample distribution. Therefore, the k-NN classifier does not require classification according to a specific parameter. Instead, it will classify a new data point with a k number which is usually an odd number. As shown in *Figure 15*, If $k = 5$ it will classify the unknown data point with the nearest 5 data points [77].

Figure 15: K Nearest Neighbor Classifier.

3.4.3. Linear Discriminant Analysis (LDA) Classifier

The linear discriminant analysis classifier is a machine learning algorithm that does dimensionality reduction. LDA is commonly used to reduce the number of data points in the data to the more computational friendly amount before the classification process. The newly generated dimensions are in a linear plot of pixel values that form a template [80]. As shown in *Figure 16*, when data are feed to the LDA classifier it will separate the 2 classes and group identical data together as much as possible [80].

Figure 16: Linear Discriminant Analysis (LDA) Classifier [80].

3.5. Typical Convolutional Neural Network (CNN)

Deep learning is a form of machine learning technique that is constructed with the structure of the human neural system in mind. The deep learning technique differs from the conventional machine learning as machine learning technique requires manual processing such as decomposition of ECG data, manual selection of nonlinear features to be studied, while deep learning technique is an automated self-learning capability from the multiple layers of low-level features from the initial input, to the higher-level features extracted during the training phase. A vital process such as the extraction of features is automated by the convolutional neural network (CNN) model, making the application of CNN a popular choice among the studies of ECG data classification [81].

The convolutional neural network (CNN) is a form of deep learning algorithm that is commonly used in the classification of cardiovascular disease, as well as data and image analysis studies. As shown in Figure 17, the typical CNN is mainly structured by four layers: the input, convolutional layer, max-pooling layer, and output layers, while some CNN models may be comprised of more layers such as the non-convolutional layers. The convolutional layers, also known as hidden layers, is the main component of the CNN model. Kernels of different sizes are used in the hidden layer to breakdown the inputs, which are analyzed using various feature maps. Classification in the successive layers will be done using features that are created. For better detection or classification of data by the kernels, deeper layers are used. The backpropagation algorithm with weights constantly adjusted is used to train CNN models, this helps to reduce errors and optimize training performance [82].

Figure 17: A typical 1D CNN model structure.

3.6. Recommended CNN model

Figure 18 presents the CNN model architecture proposed in this study. The proposed CNN architecture for non-subject based testing is a classic CNN model that is comprised of convolution layer, max-pooling layer, and fully connected layers. The same patient ECG data may be used for training and testing, therefore, the non-subject based CNN model will perform well in this application. However, the need for the classification model to identify the generalized feature well is necessary in order to classify the new patient ECG data accurately. To improve on the generalization for non-subject testing, a dropout rate of 0.5 is applied to layer 9 during training. The dropout rate of 0.5 means that a neuron has a 0.5 probability to be dropped out during training [82].

Table 2 shows the layers used. For non-subject based testing, layers 1,3,5,7,9,10,11 were subjected to Adam optimization parameters with a learning rate of 0.0001 together with the LeakyRelu and Softmax functions. After every convolution layer, a max-pooling layer is applied to extract the most important features. During training and testing, the model with the best validation accuracy will be considered. The fully connected layer will be used to perform the classification [82,83].

Figure 18: Proposed non-subject based testing using CNN model.

Table 2: Layers of the developed non-subject based CNN model parameters.

Layers	Type of Layer	No. of Neurons (Output Layers)	Kernel Size	Stride
1	Convolution	1998 x 12	3	1
2	Max pooling	999 x 12	2	2
3	Convolution	997 x 24	3	1
4	Max pooling	498 x 24	2	2
5	Convolution	496 x 24	3	1
6	Max pooling	248 x 24	2	2
7	Convolution	246 x 48	3	1
8	Max pooling	123 x 28	2	2
9	Fully connected	20	-	-
10	Fully connected	10	-	-
11	Fully connected	2	-	-

Chapter Four: RESULTS AND DISCUSSION

4.1. Features Extraction

A total of 1505 nonlinear features were extracted from the 157 segments of processed healthy and HPY ECG signals. Nonlinear features such as RQA, HOS bispectrum, HOS cumulant, approximate entropy, sample entropy, fuzzy entropy, Kolmogorov Sinai entropy, modified multiscale entropy, permutation entropy, Shannon entropy, Renyi entropy, Tsallis entropy, wavelet entropy. These features extracted are measurements used to help identify the differences between the healthy ECG and HPY ECG samples.

4.2. Statistical Analysis

Statistical analysis using a two-tailed Student “T” test was introduced to the healthy and HPY ECG data’s nonlinear features that were extracted. This will help to reduce the uniquely different features for both the classes of ECG data. This helps to ensure that the nonlinear features used are unique differences between the healthy and HPY group of ECG data. Features that achieved a probability value of ≤ 0.05 will be used for classification.

Out of the 1505 features extracted, a total of 1463 features achieved a probability value of ≤ 0.05 was recorded down for classification as shown in Table A. However, as shown in Table 3 only the top 50 features were used for classification as they are the most significant and this will help in reducing the time and computational power needed to run the developed intelligence diagnostic tool. Figure 19 shows the bar plot of the means for the top 50 features for healthy and hypertension patients.

Table 3: Top 50 extracted features used for classifications $P \leq 0.05$.

Features	Healthy		Hypertension		p-Value
	Mean	SD	Mean	SD	
imf2_Fuzzy Entropy	0.808752	0.10433	0.545949	0.110811	0
imf4_Renyi Entropy	-14.2301	1.409912	-11.0351	1.510081	0
imf3_Renyi Entropy	-14.5654	1.284436	-11.4239	1.515743	0
imf2_Renyi Entropy	-14.8156	1.167461	-11.8226	1.46294	0
imf1_Renyi Entropy	-14.4338	1.242426	-11.4262	1.484148	0
imf3_Shanon Entropy	-291873	263438.8	-46358.4	86378.1	0
imf2_Shanon Entropy	-329547	271428.7	-58553	103375.1	0
imf1_Shanon Entropy	-263352	204324.7	-46378.3	90016.51	0
imf4_Shanon Entropy	-244171	236336.8	-36264.6	84275.65	0
imf1_Fuzzy Entropy	0.74181	0.210012	0.475291	0.135013	0
imf5_Renyi Entropy	-13.0645	1.678271	-10.1517	1.623951	0
imf3_Fuzzy Entropy	0.620056	0.115177	0.410892	0.12017	0
imf3_Tsallis Entropy	-698232	1090707	-39922.5	211959.4	0
imf4_Fuzzy Entropy	0.414934	0.096835	0.262567	0.108095	0
imf3_Wavelet Entropy	-5055529	8913099	-225421	1776202	0
imf5_Shanon Entropy	-136516	179869.6	-20841.3	61429.68	0
imf4_Tsallis Entropy	-615017	1029787	-44986	319970.4	0
imf2_Tsallis Entropy	-585271	849406.3	-42126.3	385927.1	0
imf1_HOS135	8.755424	19.51197	0.351453	3.396737	0
imf1_HOS136	8.635677	19.59256	0.33221	3.113123	0
imf5_Fuzzy Entropy	0.228331	0.119396	0.125014	0.089208	0
imf1_Tsallis Entropy	-295219	382009.8	-22755.4	225492.4	0
imf1_HOS124	5.016032	11.77175	0.202508	2.018642	0
imf1_HOS134	8.620711	17.8233	0.441155	4.79333	0
imf1_HOS120	9.246637	19.00796	0.482685	5.256893	0
imf1_HOS110	9.336884	22.1857	0.379079	3.722892	0
imf1_HOS97	14.4456	34.66634	0.597205	5.887211	0
imf4_Wavelet Entropy	-4374607	8562640	-275715	2728413	0
imf1_HOS85	19.63764	47.4476	0.825451	8.188647	0
imf1_HOS74	24.11509	58.50618	1.025448	10.22566	0
imf1_HOS64	27.14391	66.0017	1.162013	11.62424	0

imf1_HOS55	28.2143	68.65301	1.21049	12.12185	0
imf1_HOS125	9.593322	22.58101	0.469896	4.998021	0
imf1_HOS68	8.19E-14	2.05E-13	3.43E-15	4.13E-14	0
imf1_HOS80	6.62E-14	1.63E-13	2.95E-15	3.62E-14	0
imf3_HOS123	0.759636	2.131627	0.025408	0.229963	0
imf1_HOS57	9.60E-14	2.44E-13	4.00E-15	4.86E-14	0
imf1_HOS111	17.5513	41.11031	0.959522	10.62727	0
imf1_HOS23	7.99E-14	2.03E-13	3.43E-15	4.15E-14	0
imf3_HOS109	2.372705	6.710374	0.078388	0.720748	0
imf1_HOS47	1.04E-13	2.68E-13	4.37E-15	5.33E-14	0
imf1_HOS17	6.38E-14	1.61E-13	2.83E-15	3.43E-14	0
imf3_HOS96	4.660665	13.2416	0.153275	1.424351	0
imf1_HOS30	9.58E-14	2.46E-13	4.08E-15	5.00E-14	0
imf3_HOS134	1.578278	4.507651	0.052632	0.466624	0
imf3_HOS84	7.280041	20.74065	0.238883	2.234672	0
imf1_HOS38	1.05E-13	2.70E-13	4.43E-15	5.44E-14	0
imf3_HOS73	9.797585	27.96013	0.321101	3.016191	0
imf3_HOS63	11.77642	33.64025	0.385699	3.631728	0
imf3_HOS120	1.862765	5.340983	0.061587	0.549071	0

Figure 19: Bar plot of the top 50 features for healthy and hypertension.

4.3. Classification results

Table 4 records the classification results of the three classifiers employed. As shown in the table, a high accuracy of 97.70% was produced by the k-NN classifier, outperforming the DT and LDA classifiers used. This could be due to the larger number of training features that was inputted into the k-NN classifier, versus the number of training features inputted into the DT classifier. For the LDA classifier, the accuracy decreases due to a larger number of features inputted to train the classifier [84].

Figure 20 shows the accuracy, sensitivity, and specificity line plot for the k-NN classifier, and it can be seen that the classifier achieved the highest accuracy, sensitivity, and specificity with 21 features and remained consistent even with all 50 features. Figure 21 shows the accuracy, sensitivity, and specificity line plot for the LDA classifier, and it can be seen that the classifier achieved the highest accuracy and sensitivity with 47 features and remained consistent even with all 50 features. However, for the LDA classifier, the highest specificity was achieved with 5 features and started declining with more features. Figure 22 shows the accuracy, sensitivity, and specificity line plot for the DT classifier, and it can be seen that the classifier achieved the highest accuracy, sensitivity, and specificity with 17 features and remained consistent even with all 50 features

As the k-NN classifier achieved the best results amount the three classifiers, a boxplot was used to study the significant features. Figure 23 shows the boxplot of the 12 best performing nonlinear features extracted by the k-NN classifier. Figure 23, proves that for healthy patients the ECG variability is low as compared to HPY patients, and therefore has a lower mean value of Shannon entropy and Rényi entropy.

Table 5 records the classification results of the CNN model employed with the model validated with 10-fold and leave one patient out validation technique. As shown in the table, the CNN model validated by 10-fold validation technique produced a slightly better specificity of 99.97%, accuracy of 99.99%, sensitivity of 100.00%, as compared to the CNN model validated with leave one patient out validation technique which achieved a specificity of 99.92%, accuracy of 99.99% and sensitivity of 99.99%. Table 5 records the performance of the CNN model with dropout added to layer 9 during training. Figure 24(a) represents the accuracy plot for the 10-fold validation technique, and Figure 24(b) represents the accuracy plot to leave one patient out validation technique. It is notable that in terms of the accuracy of the training set, both validation techniques did not vary substantially from the validation set. Based on Figure 25(a), it is clear that 0.033% of healthy patients are incorrectly classified as HPY patients, and 100.00% of HPY patients are correctly classified as HPY patients. In Figure 25(b), 0.077% of healthy patients are incorrectly classified as HPY patients, and 100.00% of HPY patients are correctly classified as HPY patients.

Table 4: Proposed EMD techniques' classification results.

Classifier	k-NN	LDA	DT
No. of features	21	47	17
Accuracy (%)	97.70	93.30	96.6
Sensitivity (%)	98.90	97.0	98.10
Specificity (%)	89.10	65.20	85.40
Positive predictive value (%)	98.60	95.50	98.10

Figure 20: Line plot of accuracy, sensitivity, and specificity for the k-NN classifier.

Figure 21: Line plot of accuracy, sensitivity, and specificity for the LDA classifier.

Figure 22: Line plot of accuracy, sensitivity, and specificity for the DT classifier.

Figure 23: Boxplots of the 21 best performing features for k-NN classifier.

Table 5: Proposed CNN techniques' classification results.

Classifier	Validation	Accuracy (%)	Sensitivity (%)	Specificity (%)	Positive predictive value (%)
CNN	10-Fold	99.99	100	99.97	99.99
CNN	One Patient out	99.99	100	99.92	99.99

(a)

(b)

Training set: —

Validation set: —

Figure 24: Accuracy plot for (a) 10-fold validation and (b) leave one patient out validation.

Figure 25: Confusion matrix of (a) 10-fold validation technique and (b) leave one patient out validation technique.

4.4. Comparison of hypertension work

Table 6: Summarized authors' work using IDT to detect/diagnose HPY using ECG signals.

Authors	Techniques	Number of participants	Results
Rajput et al. [85], 2019	<ul style="list-style-type: none"> • OWFB • SFD • LOGE • HDI • Student's t-test 	Physionet (SHAREE) database: High-risk HPY: 17 patients Low-risk HPY: 122 subjects	HDI system classified high and low-risk HPY classes with 100% classification accuracy.
Simjanoska et al.[86], 2018	<ul style="list-style-type: none"> • Intricacy features (signal mobility, intricacy, fractal dimension, entropy, autocorrelation, age) • Flat ML design • Stacking ML design • Leave-one-instance-out-cross validation Estimation of blood pressure class	20 subjects	Accuracy: 96.8%

Simjanoska et al.[87], 2018	<ul style="list-style-type: none"> • Intricacy parameters • Stacking ML method • Random forest classifier • Train-validation-test-evaluation 	Charis Phyonet database (7 subjects) + readings from 3 different sensors (44 subjects): 51 subjects	The proposed system achieves results of similar accuracy to that of a qualified medical device.
Takase et al. [88], 2016	<ul style="list-style-type: none"> • Convolutional Neural Network (CNN) • Sokolow-Lyon voltage • Cornell product • SPSS statistic 18 	5770 healthy patients	LVH defined by ECG is a powerful tool for the detection on hypertension onset.
Nakatsuji et al.[89], 2015	<ul style="list-style-type: none"> • R wave amplitude • R/S ratio • Syn-ECG compared with 12-lead ECG Student's t-test/ Mann-Whitney test 	Healthy: 30 subjects HPY: 30 patients	Proposed system obtained a higher AUC values of 80.2% and 82.3% for R wave amplitude and R/S ratio, respectively.
Scherpong et al.[90], 2012	<ul style="list-style-type: none"> • ECG-based ventricular gradient • Matlab • ECG parameters 	ECG database management system: Healthy: 99 healthy HPY: 117 patients	Reduced VGx is related to HPY and patients with severely reduced VGx have higher mortality.

Present study [84] (2 class)	<ul style="list-style-type: none"> • Nonlinear features • EMD • Student's t-test • k-NN, LDA, DT classifiers • CNN model • 10-fold validation • Leave one patient out validation 	MIT-BIH healthy sinus rhythm database, SHAREE database: Healthy: 18 sets of ECG signals HPY: 139 sets of ECG signals	<u>k-NN classifier</u> Accuracy: 97.70% Sensitivity: 98.90% Specificity: 89.10% Positive predictive value: 98.60% <u>CNN Model</u> Accuracy: 99.99% Sensitivity: 99.99% Specificity: 99.97% Positive predictive value: 99.99%
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In recent years, multiple diagnostic techniques have also been studied by researchers as shown in Table 6. Rajput et al. [85] divided the ECG data into epochs of 5 minutes duration, after the capturing of ECG signals. The introduction of optimal orthogonal wavelet filter bank (OWFB) was then used for the decomposition of the ECG data into six wavelet sub-bands. Thereafter, the sub-bands were used to extract the signal fractional dimensional (SFD) and log energy (LOGE) features. Student's t-test was introduced to select distinctly different features. A special hypertension diagnosis index (HDI) was therefore developed to differentiate between low-risk and high-risk HPY classes using two feature sets from SFD and LOGE. The developed index system using a sample size of 51 patient was able to achieve classification of the high and low-risk HPY classes with 100% accuracy [84].

Simjanoska et al. [86] processed the ECG signals after acquisition. Six intricacy features were then extracted from the signals to form a feature vector, after which they were classified using two approaches: flat machine learning (ML) and stacking ML design. The flat ML design comprised seven differing classifiers (k-nearest neighbor, J48, Naïve Bayes, support vector machine, random forest, bagging, boosting classifiers) which were trained with the signals. In the stacking design, each of the seven classifiers was altered to provide prediction probabilities for a particular feature vector. The random forest classifier was then trained with the new vector. Leaving-one-instance-out-cross validation was used to validate both methods, wherein the stacking design yielded the highest accuracy of 96.8% with a sample size of 20 patients.

In another study, Simjanoska et al. [87] extracted intricacy parameters from the acquired signals, before subjecting them to the stacking design method as explained in the previous study. Three random forest classifiers were then trained with the formed vectors, and were subsequently used to forecast the systolic, diastolic, and mean arterial pressures. The train-validation-test-evaluation was employed to validate the proposed system whereby 60% of the data was used for training, 10% for validation and the remaining 30% for testing. The results indicate that the system is able to achieve results, of similar accuracy, to that of a qualified medical device, for estimation of blood pressure.

Takase et al. [88] developed a convolutional neural network to identify LVH from ECG signals of 5770 subjects. The subjects were initially healthy at the start of the study, and endpoint was when they are diagnosed with HPT. The Sokolow–Lyon voltage and Cornell product were used as parameters to identify LVH from the ECG signals. Statistical analysis using the IBM SPSS 18 was introduced to capture significant data. In their finding, they mentioned LVH defined by ECG is a powerful tool for the detection of hypertension onset. However, the classification results were not reported.

Nakatsuji et al. [89] compared the diagnostic capabilities of R wave amplitude and R/S ratio parameters extracted from the conventional 12-lead ECG signals and the synthesized right-sided chest ECG(Syn-ECG). Student's t-test or Mann-Whitney test were used to make comparisons of parameters between the two groups. The diagnostic criteria for HPY derived from the proposed Syn-ECG method yielded higher AUC values 80.2% and 82.3% for R wave amplitude and R/S ratio respectively, as compared to the conventional method.

Scherpong et al. [90] explored an array of ECG parameters for the detection of HPY. The ventricular gradient projected on the x-axis (VGx) was computed using Matlab software, after the acquisition of ECG signals. The best parameter was discovered to be VGx, whereby lower VGx values in patients were found to be correlated to HPY, while largely reduced VGx values in HPY patients were found to be related to mortality.

Chapter Five: CONCLUSION AND FUTURE WORK

Secluded habits or an unhealthy lifestyle can cause an increase in blood pressure over time, causing an increased chance of having hypertension. The cardiovascular, cerebrum, or kidney-related medical conditions may result from HPY, hence, providing an accurate and time-saving diagnosis for HPY is assertive. Thus, an intelligence diagnostic tool (IDT) using electrocardiograms (ECG) data for HPY and also MHPY diagnosis is proposed in this research work. Two techniques will be used in this study, the empirical mode decomposition (EMD) and a convolutional neural network (CNN) model.

EMD is introduced for the five-level of decomposition for the processed signals. Thereafter, the intrinsic mode functions (IMFs) are used to extract nonlinear features from the processed signals. Distinctly different features are then recorded after applying the student's t-test to the nonlinear features. The selected nonlinear features are then fed to three different classifiers, whereas, the highest accuracy of 97.70% is recorded by the k-NN classifier. To make the proposed tools more accurate, the 10-fold cross-validation technique was employed to reduce the inconsistency by averaging the results.

The processed signals were also be feed into a CNN model. The CNN model will learn and identify the ECG signatures unique and classify the healthy and the HPY ECG signals. The 10-fold cross and leave one out patient based validation technique are used to evaluate the developed tool. The 10-fold cross-validation technique achieved an accuracy of 99.99%, sensitivity of 99.99%, specificity of 99.97%, and a positive prediction values of 99.99%, while for the leave one out patient based validation an accuracy of 99.99%, sensitivity of 99.99%, specificity of 99.92% and a positive predictive value of 99.99%. Our findings suggest that while the CNN model performed slightly better than the EMD technique, the developed systems are useful as an intelligence diagnostic tool in the clinical settings and that it allows the autonomous diagnostic of HPY and healthy ECG signals.

Hence, the proposed IDT is probable to be employed as an intelligence diagnostic tool for HPY and has the possibility to make the jobs of medical staffs simpler. In addition, the developed system could potentially be employed for the detection of masked hypertension, by recognizing the ECG morphology of HPY to diagnose HPY, even when the on-the-spot blood pressure was shown to be healthy.

Future research will study on classification of the ECG signal into the severity of hypertension, such as low-risk hypertension, and high-risk hypertension by using deep learning approaches. This is because the 24-hour ABPM and the current work is done is only able to diagnose if the patient is healthy or having hypertension, and not the diagnosis of the risk factor of the possible onset of cardiovascular or cerebrovascular related disease [97,98,99,100].

A patient is classified as having low-risk hypertension when no major cardiovascular or cerebrovascular diseases were recorded during twelve-months of monitoring. Likewise, a patient is classified as having high-risk hypertension when a major cardiovascular or cerebrovascular disease emerges during a twelve-months monitoring program. Thus, it is important to be able to have early identification of patients with possible onset of major cardiovascular or cerebrovascular disease. Hence, prevent or reduce the possibility of having these adverse events from happening [97,98,99,100].

In fact, future research work will be using deep learning techniques such as Convolutional Neural Network (CNN) to classify ECG signals into the severity of hypertension, such as low-risk hypertension, and high-risk hypertension. The advantage of using the proposed deep learning techniques is that processes such as feature extractions and ranking are not required before the classification of the signals. The deep learning techniques when feed with the ECG signals will automatically learn and adapt to the ECG signal and differentiate the healthy and hypertension patients [97,98,99,100].

Figure 26: Flow diagram for proposed future work.

Figure 26 illustrates the proposed methodology for future research work. Firstly, raw healthy and HPY ECG signals will be downloaded from the physiobank. Secondly, the raw ECG signals will be segmented into two thousand sampling points and healthyized using Z-score healthyization, this helps to eliminate the scaling problem of the ECG signals that could cause inaccuracy during training and testing of the neural network. Thirdly, the processed ECG signals will be feed to the neural network that will study and learn the underlying relationships of the ECG signals fed. Fourthly, training of the neural network will be done using 90% of the ECG dataset, this helps to improve on the accuracy, sensitivity, and specificity of the classifications. Lastly, 10% of the ECG dataset will be used for testing and the process is repeated for ten times and the overall average of the ten results will be computed, making it ten-fold cross-validation [97,98,99,100].

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Appendix A: Student 'T' Test results

Table A: Student 'T' test results

	Healthy		Hypertension		p-Value	t-Value
	Mean	SD	Mean	SD		
imf2_Fuzzy Entropy	0.808752	0.10433	0.545949	0.110811	0	212.9511
imf4_Renyi Entropy	-14.2301	1.409912	-11.0351	1.510081	0	190.1426
imf3_Renyi Entropy	-14.5654	1.284436	-11.4239	1.515743	0	187.9698
imf2_Renyi Entropy	-14.8156	1.167461	-11.8226	1.46294	0	186.455
imf1_Renyi Entropy	-14.4338	1.242426	-11.4262	1.484148	0	183.9809
imf3_Shanon Entropy	-291873	263438.8	-46358.4	86378.1	0	180.9659
imf2_Shanon Entropy	-329547	271428.7	-58553	103375.1	0	180.2125
imf1_Shanon Entropy	-263352	204324.7	-46378.3	90016.51	0	176.6367
imf4_Shanon Entropy	-244171	236336.8	-36264.6	84275.65	0	164.1945
imf1_Fuzzy Entropy	0.74181	0.210012	0.475291	0.135013	0	163.1597
imf5_Renyi Entropy	-13.0645	1.678271	-10.1517	1.623951	0	159.3598
imf3_Fuzzy Entropy	0.620056	0.115177	0.410892	0.12017	0	155.992
imf3_Tsallis Entropy	-698232	1090707	-39922.5	211959.4	0	139.3044
imf4_Fuzzy Entropy	0.414934	0.096835	0.262567	0.108095	0	127.1939
imf3_Wavelet Entropy	-5055529	8913099	-225421	1776202	0	124.3604
imf5_Shanon Entropy	-136516	179869.6	-20841.3	61429.68	0	122.5551
imf4_Tsallis Entropy	-615017	1029787	-44986	319970.4	0	110.0432
imf2_Tsallis Entropy	-585271	849406.3	-42126.3	385927.1	0	104.4016
imf1_HOS135	8.755424	19.51197	0.351453	3.396737	0	101.6791
imf1_HOS136	8.635677	19.59256	0.33221	3.113123	0	101.6547
imf5_Fuzzy Entropy	0.228331	0.119396	0.125014	0.089208	0	98.86758
imf1_Tsallis Entropy	-295219	382009.8	-22755.4	225492.4	0	97.70283
imf1_HOS124	5.016032	11.77175	0.202508	2.018642	0	96.80177
imf1_HOS134	8.620711	17.8233	0.441155	4.79333	0	96.5091
imf1_HOS120	9.246637	19.00796	0.482685	5.256893	0	95.98353
imf1_HOS110	9.336884	22.1857	0.379079	3.722892	0	95.95835
imf1_HOS97	14.4456	34.66634	0.597205	5.887211	0	94.73682
imf4_Wavelet Entropy	-4374607	8562640	-275715	2728413	0	94.13807
imf1_HOS85	19.63764	47.4476	0.825451	8.188647	0	93.75076
imf1_HOS74	24.11509	58.50618	1.025448	10.22566	0	93.09758
imf1_HOS64	27.14391	66.0017	1.162013	11.62424	0	92.72732
imf1_HOS55	28.2143	68.65301	1.21049	12.12185	0	92.60761
imf1_HOS125	9.593322	22.58101	0.469896	4.998021	0	90.30018
imf1_HOS68	8.19E-14	2.05E-13	3.43E-15	4.13E-14	0	87.81652
imf1_HOS80	6.62E-14	1.63E-13	2.95E-15	3.62E-14	0	86.87891
imf3_HOS123	0.759636	2.131627	0.025408	0.229963	0	86.46545
imf1_HOS57	9.6E-14	2.44E-13	4E-15	4.86E-14	0	86.44495
imf1_HOS111	17.5513	41.11031	0.959522	10.62727	0	86.04379
imf1_HOS23	7.99E-14	2.03E-13	3.43E-15	4.15E-14	0	85.96031

imf3_HOS109	2.372705	6.710374	0.078388	0.720748	0	85.8587
imf1_HOS47	1.04E-13	2.68E-13	4.37E-15	5.33E-14	0	85.72093
imf1_HOS17	6.38E-14	1.61E-13	2.83E-15	3.43E-14	0	85.47287
imf3_HOS96	4.660665	13.2416	0.153275	1.424351	0	85.46938
imf1_HOS30	9.58E-14	2.46E-13	4.08E-15	5E-14	0	85.29478
imf3_HOS134	1.578278	4.507651	0.052632	0.466624	0	85.23799
imf3_HOS84	7.280041	20.74065	0.238883	2.234672	0	85.22943
imf1_HOS38	1.05E-13	2.7E-13	4.43E-15	5.44E-14	0	85.11516
imf3_HOS73	9.797585	27.96013	0.321101	3.016191	0	85.08107
imf3_HOS63	11.77642	33.64025	0.385699	3.631728	0	84.99427
imf3_HOS120	1.862765	5.340983	0.061587	0.549071	0	84.97495
imf3_HOS54	12.86402	36.76374	0.421195	3.970405	0	84.95399
imf1_HOS126	15.75352	36.47087	0.913776	10.36029	0	83.86015
imf1_HOS98	26.6231	62.29123	1.533099	17.26764	0	83.77853
imf1_HOS123	2.929759	6.233266	0.174646	2.175544	0	83.36493
imf1_HOS109	7.578844	15.87032	0.467964	5.783323	0	82.7318
imf1_HOS86	35.30962	82.60759	2.090152	23.73809	0	82.51447
imf1_HOS96	13.67202	28.68584	0.85467	10.48318	0	82.38424
imf3_HOS133	4.387633	13.05012	0.140427	1.280111	0	82.2809
imf1_HOS84	20.43841	43.10687	1.282789	15.64814	0	82.21023
imf1_HOS73	26.8507	56.89042	1.686964	20.50068	0	82.13027
imf1_HOS63	31.8541	67.70396	2.00172	24.26517	0	82.09239
imf1_HOS54	34.59415	73.64352	2.173822	26.31997	0	82.07726
imf1_HOS93	5.35E-14	1.32E-13	2.63E-15	3.41E-14	0	82.0293
imf3_HOS132	7.885579	23.54815	0.250246	2.310909	0	81.97253
imf2_HOS52	86.26655	236.069	0.21317	51.06879	0	81.97106
imf3_HOS108	3.097343	9.259625	0.098604	0.899731	0	81.92836
imf3_HOS121	3.097343	9.259625	0.098604	0.899731	0	81.92836
imf3_HOS30	2.77E-14	7.7E-14	1.12E-15	1.3E-14	0	81.8912
imf3_HOS131	11.2732	33.70455	0.356684	3.315337	0	81.86972
imf3_HOS95	8.367265	25.04309	0.26558	2.433621	0	81.84145
imf1_HOS75	42.12083	98.55337	2.530473	28.86182	0	81.82018
imf3_HOS130	13.79444	41.26532	0.435822	4.0684	0	81.81539
imf3_HOS83	15.07593	45.1401	0.477855	4.389574	0	81.80866
imf3_HOS72	22.13961	66.30171	0.701225	6.451245	0	81.79298
imf3_HOS62	28.34229	84.88428	0.897305	8.262834	0	81.7847
imf3_HOS53	32.57976	97.57942	1.031236	9.500943	0	81.78054
imf3_HOS129	14.84749	44.42876	0.468674	4.391186	0	81.77926
imf3_HOS45	34.08388	102.0857	1.078771	9.940498	0	81.77926
imf3_HOS128	14.13493	42.3042	0.445902	4.194542	0	81.74798
imf3_HOS127	11.7589	35.19751	0.370785	3.507067	0	81.71062
imf3_HOS126	8.2294	24.638	0.259483	2.478087	0	81.63899
imf3_HOS119	5.797621	17.42118	0.184346	1.692357	0	81.51449
imf1_HOS65	45.85963	107.3101	2.773197	31.68867	0	81.50939
imf3_HOS125	4.381362	13.13538	0.13845	1.354881	0	81.37072
imf3_HOS38	3.01E-14	8.4E-14	1.22E-15	1.45E-14	0	81.20947
imf3_HOS118	11.2269	33.90494	0.354153	3.288904	0	81.13609

imf3_HOS111	9.349738	28.20141	0.293947	2.840243	0	81.03333
imf3_HOS117	16.99682	51.40369	0.53469	4.991889	0	81.02097
imf3_HOS112	16.05247	48.51385	0.503624	4.788551	0	80.99469
imf3_HOS47	2.95E-14	8.24E-14	1.21E-15	1.43E-14	0	80.98543
imf3_HOS116	21.84413	66.10121	0.68627	6.428143	0	80.97056
imf3_HOS113	21.51862	65.09675	0.675014	6.378893	0	80.957
imf3_HOS105	12.4318	37.63394	0.391657	3.643551	0	80.95548
imf3_HOS115	24.61692	74.50617	0.772786	7.257603	0	80.94789
imf3_HOS114	24.55752	74.32025	0.770546	7.256033	0	80.94336
imf3_HOS106	7.098667	21.51818	0.223676	2.072657	0	80.8739
imf3_HOS94	7.098667	21.51818	0.223676	2.072657	0	80.8739
imf3_HOS98	15.13647	45.79208	0.475074	4.574129	0	80.84387
imf3_HOS82	17.35968	52.66108	0.546332	5.072765	0	80.81726
imf3_HOS71	29.20181	88.61102	0.918423	8.537767	0	80.79354
imf3_HOS61	40.62977	123.3057	1.277368	11.88315	0	80.78205
imf3_HOS52	49.63174	150.6358	1.560059	14.51912	0	80.77628
imf3_HOS44	54.58472	165.6731	1.715584	15.96969	0	80.77383
imf3_HOS104	20.19942	61.29883	0.634374	5.935392	0	80.76429
imf3_HOS86	20.74877	62.86875	0.650743	6.256318	0	80.74134
imf3_HOS57	2.67E-14	7.51E-14	1.08E-15	1.29E-14	0	80.71156
imf3_HOS99	24.38935	74.00652	0.763851	7.260628	0	80.70797
imf3_HOS75	25.18298	76.36737	0.789532	7.585438	0	80.68626
imf3_HOS103	27.43887	83.3578	0.860462	8.077477	0	80.67728
imf3_HOS65	27.62676	83.80854	0.86602	8.317929	0	80.66186
imf3_HOS100	31.06116	94.36752	0.972562	9.199967	0	80.6438
imf3_HOS102	32.43903	98.59296	1.016423	9.565054	0	80.63631
imf3_HOS101	33.85311	102.8943	1.060213	10.00039	0	80.62508
imf3_HOS91	29.43801	89.52225	0.922719	8.667594	0	80.60083
imf3_HOS136	1.196115	3.591311	0.038878	0.405815	0	80.57124
imf3_HOS87	31.75614	96.54901	0.993795	9.44743	0	80.56652
imf3_HOS90	36.7745	111.9419	1.151484	10.84576	0	80.52132
imf1_HOS133	10.20062	20.79342	0.691435	8.296123	0	80.51243
imf3_HOS88	38.6283	117.5885	1.208526	11.43999	0	80.49872
imf3_HOS76	36.80646	112.0087	1.151429	10.94722	0	80.49838
imf3_HOS81	12.33066	37.56492	0.387013	3.611686	0	80.49125
imf3_HOS92	12.33066	37.56492	0.387013	3.611686	0	80.49125
imf3_HOS89	40.25168	122.5657	1.259627	11.89209	0	80.48935
imf3_HOS66	38.60195	117.5058	1.20747	11.48051	0	80.47787
imf3_HOS78	42.53035	129.5714	1.330645	12.56607	0	80.45063
imf3_HOS70	28.12506	85.72759	0.882182	8.242577	0	80.44991
imf2_HOS53	116.8502	322.7476	0.284411	72.31987	0	80.44834
imf3_HOS77	42.80609	130.4111	1.3388	12.6773	0	80.43908
imf3_HOS60	44.79695	136.5812	1.40461	13.1333	0	80.42901
imf3_HOS51	59.4533	181.2922	1.863765	17.43407	0	80.41785
imf3_HOS43	69.47128	211.855	2.177567	20.37427	0	80.41227
imf3_HOS36	73.02795	222.7059	2.288969	21.41821	0	80.41056
imf3_HOS69	18.05435	55.13836	0.565572	5.298307	0	80.30006

imf3_HOS79	18.05435	55.13836	0.565572	5.298307	0	80.30006
imf2_HOS134	4.177396	10.17525	0.270963	2.778423	0	80.29558
imf2_HOS120	4.756142	11.64939	0.304213	3.140898	0	80.29338
imf3_HOS59	38.98693	119.1127	1.220846	11.44588	0	80.27007
imf3_HOS50	59.22803	180.9917	1.85426	17.39275	0	80.25336
imf3_HOS42	75.18726	229.7873	2.353588	22.08265	0	80.2442
imf3_HOS35	83.97192	256.6483	2.628415	24.66449	0	80.24011
imf3_HOS58	23.33976	71.38324	0.730335	6.857901	0	80.18801
imf3_HOS67	23.33976	71.38324	0.730335	6.857901	0	80.18801
imf3_HOS49	48.07025	147.0609	1.503817	14.12855	0	80.16621
imf3_HOS41	69.84995	213.7259	2.18484	20.53366	0	80.15356
imf3_HOS34	84.74979	259.3382	2.650678	24.91625	0	80.14688
imf3_HOS28	90.04154	275.5386	2.816113	26.47287	0	80.14478
imf2_HOS63	109.4062	319.2588	0.1041	58.05587	0	80.14029
imf3_HOS48	27.24502	83.40479	0.851936	8.012224	0	80.11565
imf3_HOS56	27.24502	83.40479	0.851936	8.012224	0	80.11565
imf3_HOS40	53.67181	164.3383	1.678008	15.78718	0	80.09968
imf3_HOS33	74.54003	228.2618	2.330208	21.92824	0	80.09044
imf3_HOS27	86.03509	263.4771	2.689432	25.31141	0	80.08618
imf2_HOS64	140.5106	408.4764	0.145156	75.9414	0	80.07369
imf1_HOS127	21.41227	49.26648	1.348003	15.70912	0	80.06601
imf3_HOS46	29.01386	88.87657	0.906819	8.537654	0	80.06575
imf3_HOS39	29.01386	88.87657	0.906819	8.537654	0	80.06575
imf3_HOS32	54.62837	167.365	1.707196	16.07751	0	80.05411
imf3_HOS26	72.17305	221.1345	2.255342	21.24287	0	80.04777
imf3_HOS21	78.40734	240.2422	2.450108	23.07847	0	80.04576
imf3_HOS31	28.2463	86.56492	0.882536	8.315562	0	80.03003
imf3_HOS37	28.2463	86.56492	0.882536	8.315562	0	80.03003
imf3_HOS25	50.59272	155.0652	1.580609	14.89588	0	80.02174
imf3_HOS20	62.91301	192.8361	1.965443	18.52429	0	80.01783
imf3_HOS24	25.00276	76.65018	0.781006	7.363176	0	80.00392
imf3_HOS29	25.00276	76.65018	0.781006	7.363176	0	80.00392
imf3_HOS19	42.15124	129.2311	1.316601	12.41425	0	79.99827
imf3_HOS15	48.2482	147.9271	1.507015	14.21026	0	79.99645
imf3_HOS22	19.81643	60.76551	0.618894	5.837309	0	79.98472
imf3_HOS18	19.81643	60.76551	0.618894	5.837309	0	79.98472
imf1_HOS112	27.63523	63.95929	1.736026	20.17557	0	79.9815
imf3_HOS14	30.7515	94.30123	0.96038	9.058868	0	79.98124
imf3_HOS13	13.6075	41.73373	0.424927	4.009095	0	79.97078
imf3_HOS16	13.6075	41.73373	0.424927	4.009095	0	79.97078
imf3_HOS10	18.44796	56.58045	0.576074	5.435331	0	79.96915
imf3_HOS9	7.51414	23.04847	0.234627	2.214135	0	79.96106
imf3_HOS11	7.51414	23.04847	0.234627	2.214135	0	79.96106
imf3_HOS1	2.673866	8.202315	0.083486	0.787954	0	79.95489
imf3_HOS6	2.673866	8.202315	0.083486	0.787954	0	79.95489
imf3_HOS7	2.673866	8.202315	0.083486	0.787954	0	79.95489
imf3_HOS55	12.42606	37.76292	0.397062	4.140495	0	79.85539

imf3_HOS64	11.87606	36.09612	0.379535	3.960377	0	79.84032
imf3_HOS68	2.31E-14	6.62E-14	9.07E-16	1.1E-14	0	79.83597
imf2_HOS51	56.70918	163.4341	0.086848	32.03857	0	79.80607
imf3_HOS74	10.32873	31.40629	0.330225	3.453299	0	79.79126
imf3_HOS85	8.07062	24.56039	0.258266	2.712181	0	79.69395
imf2_HOS65	166.8748	487.8735	0.143459	90.96989	0	79.58646
imf3_HOS97	5.512597	16.80193	0.176755	1.870409	0	79.51024
imf2_HOS54	144.7926	404.5101	0.299546	91.27068	0	79.41274
imf1_HOS119	12.49293	25.48859	0.867522	10.39233	0	79.34042
imf3_HOS23	2.33E-14	6.74E-14	9.48E-16	1.09E-14	0	79.19349
imf3_HOS110	3.105327	9.49577	0.100076	1.074595	0	79.12332
imf2_HOS57	5.74E-14	1.38E-13	3.64E-15	4.11E-14	0	78.67666
imf2_HOS66	184.7753	548.4511	0.10897	101.5196	0	78.53099
imf2_HOS55	166.1677	470.4176	0.267333	106.0252	0	78.42767
imf1_HOS12	5.48E-14	1.45E-13	2.74E-15	3.46E-14	0	78.34324
imf1_HOS99	40.17624	93.17037	2.611287	30.63558	0	78.19018
imf2_HOS62	77.25013	233.3733	0.015978	40.64908	0	78.11992
imf2_HOS109	5.815803	14.69766	0.374492	3.923621	0	78.05803
imf2_HOS96	11.17394	28.56578	0.704121	7.423431	0	78.00017
imf3_HOS124	1.24864	3.856634	0.04103	0.455505	0	77.97486
imf2_HOS84	17.2556	44.4527	1.073812	11.36981	0	77.88477
imf2_HOS73	23.07433	59.73358	1.425113	15.13233	0	77.79037
imf2_HOS63	27.63633	71.7511	1.699448	18.07636	0	77.72818
imf2_HOS133	9.655415	25.15154	0.576624	6.309263	0	77.72489
imf2_HOS54	30.1404	78.35819	1.849711	19.69064	0	77.6978
imf2_HOS123	1.961852	4.892017	0.131681	1.368643	0	77.54928
imf2_HOS76	154.4455	476.4857	0.009058	76.9048	0	77.54383
imf1_HOS128	25.04636	57.54162	1.657607	19.63373	0	77.49306
imf2_HOS77	178.6124	551.9083	0.006135	88.78662	0	77.46624
imf2_HOS45	71.96913	189.1416	4.195353	46.89593	0	77.44631
imf2_HOS53	68.81695	180.8192	4.013805	44.85807	0	77.44589
imf2_HOS62	59.93237	157.3703	3.501679	39.11116	0	77.4443
imf2_HOS72	46.91409	123.0367	2.74991	30.68044	0	77.44038
imf2_HOS83	32.06138	83.9155	1.889431	21.04134	0	77.4314
imf2_HOS95	17.90786	46.71789	1.064857	11.82195	0	77.40992
imf2_HOS108	6.713197	17.41382	0.405699	4.477943	0	77.35872
imf2_HOS121	6.713197	17.41382	0.405699	4.477943	0	77.35872
imf1_HOS87	51.18882	118.8877	3.383899	39.87526	0	77.27636
imf2_HOS119	12.47079	32.80882	0.734336	8.151901	0	77.26418
imf2_HOS132	16.68403	44.27516	0.961072	10.75048	0	77.26032
imf2_HOS131	23.53163	62.8797	1.332052	15.02629	0	77.18641
imf2_HOS130	28.59861	76.73686	1.600848	18.14393	0	77.16481
imf2_HOS129	30.63663	82.51534	1.699232	19.33115	0	77.1275
imf2_HOS68	4.95E-14	1.29E-13	3.14E-15	3.25E-14	0	77.11254
imf2_HOS128	29.04528	78.57898	1.595671	18.22447	0	77.05407
imf2_HOS127	24.05494	65.50625	1.305436	14.98878	0	76.90317
imf1_HOS113	35.95601	82.98686	2.403019	28.47802	0	76.87592

imf1_HOS76	58.70991	136.4739	3.913177	46.20798	0	76.8269
imf2_HOS118	23.32177	62.48402	1.329411	15.08559	0	76.70956
imf1_HOS66	61.37903	142.7184	4.101278	48.45912	0	76.69032
imf2_HOS117	34.88506	94.08532	1.958367	22.4081	0	76.59035
imf2_HOS105	25.71886	69.10194	1.462091	16.65053	0	76.55123
imf2_HOS116	44.56003	120.6312	2.47774	28.47759	0	76.54897
imf2_HOS126	16.74341	46.14349	0.891134	10.32745	0	76.54762
imf2_HOS115	50.00768	135.795	2.759559	31.81898	0	76.51768
imf2_HOS94	14.79678	39.38146	0.860568	9.752409	0	76.51512
imf2_HOS106	14.79678	39.38146	0.860568	9.752409	0	76.51512
imf2_HOS82	35.9985	96.1043	2.078647	23.63235	0	76.48467
imf2_HOS114	49.71153	135.4309	2.722231	31.48267	0	76.48108
imf2_HOS71	60.37696	161.4736	3.471135	39.5359	0	76.47297
imf2_HOS61	83.85778	224.5121	4.807987	54.82277	0	76.468
imf2_HOS52	102.3344	274.1496	5.857944	66.83733	0	76.46587
imf2_HOS44	112.4948	301.4556	6.434746	73.44005	0	76.46501
imf2_HOS113	43.4036	118.7624	2.353898	27.32081	0	76.422
imf2_HOS75	123.8665	388.4998	-0.01736	62.23733	0	76.38453
imf2_HOS104	41.245	111.6793	2.308348	26.54359	0	76.34908
imf2_HOS112	32.24026	88.89236	1.721983	20.10309	0	76.2762
imf2_HOS103	55.66306	151.3617	3.0863	35.66962	0	76.26131
imf2_HOS47	6.33E-14	1.5E-13	3.99E-15	4.98E-14	0	76.22843
imf2_HOS78	192.8828	607.105	-0.01888	96.35151	0	76.22785
imf2_HOS102	65.52596	178.7512	3.607208	41.83277	0	76.20648
imf2_HOS91	59.63138	162.3611	3.303646	38.2397	0	76.18001
imf2_HOS101	68.14719	186.4713	3.725371	43.3278	0	76.16439
imf2_HOS100	62.32022	171.1616	3.377495	39.40461	0	76.12329
imf2_HOS81	25.31259	68.17089	1.447125	16.59733	0	76.10084
imf2_HOS92	25.31259	68.17089	1.447125	16.59733	0	76.10084
imf2_HOS90	74.12801	202.6026	4.076731	47.38369	0	76.08048
imf2_HOS70	57.57742	155.3592	3.278788	37.6812	0	76.06469
imf2_HOS60	91.55628	247.3218	5.200586	59.84042	0	76.04767
imf2_HOS51	121.3895	328.1333	6.884316	79.27261	0	76.03883
imf2_HOS99	48.75111	134.7196	2.606794	30.55379	0	76.03849
imf2_HOS43	141.767	383.3575	8.033002	92.53654	0	76.03445
imf2_HOS36	148.9993	402.9618	8.440466	97.24264	0	76.03311
imf2_HOS89	80.83659	221.6677	4.415334	51.48317	0	76.01487
imf2_HOS78	85.3553	234.2092	4.660959	54.38752	0	75.97063
imf2_HOS88	77.31741	212.7873	4.18855	48.99114	0	75.96749
imf2_HOS87	63.33597	175.2832	3.388305	39.79683	0	75.90048
imf2_HOS77	85.59593	235.7837	4.636145	54.28444	0	75.90025
imf2_HOS79	36.77418	99.68072	2.082535	24.04419	0	75.87202
imf2_HOS69	36.77418	99.68072	2.082535	24.04419	0	75.87202
imf2_HOS59	79.2798	215.1656	4.478719	51.78039	0	75.84235
imf2_HOS76	73.33239	203.1102	3.923926	46.13576	0	75.82937
imf2_HOS50	120.316	326.7884	6.786235	78.52472	0	75.82621
imf2_HOS42	152.6424	414.777	8.601346	99.57708	0	75.81738

imf2_HOS35	170.4281	463.2036	9.599234	111.1552	0	75.81341
imf2_HOS66	76.88593	213.0058	4.114325	48.3897	0	75.8074
imf2_HOS136	2.756209	7.733315	0.150721	1.67273	0	75.76521
imf2_HOS58	47.32173	128.7778	2.663972	30.88461	0	75.73354
imf2_HOS67	47.32173	128.7778	2.663972	30.88461	0	75.73354
imf2_HOS49	97.35755	265.1728	5.471942	63.4996	0	75.70971
imf2_HOS41	141.3725	385.2642	7.937642	92.16751	0	75.6959
imf2_HOS34	171.4649	467.4093	9.621729	111.7583	0	75.68859
imf2_HOS28	182.1492	496.5817	10.2194	118.7125	0	75.68629
imf2_HOS111	18.68972	52.57377	0.967692	11.46306	0	75.64372
imf2_HOS48	55.07495	150.2705	3.088042	35.90083	0	75.64155
imf2_HOS56	55.07495	150.2705	3.088042	35.90083	0	75.64155
imf2_HOS40	108.4153	295.9934	6.072218	70.64206	0	75.62278
imf2_HOS98	30.1352	84.62129	1.567558	18.57941	0	75.61632
imf2_HOS33	150.5007	411.0488	8.42379	98.03877	0	75.6119
imf2_HOS27	173.6729	474.4212	9.717727	113.1192	0	75.60686
imf2_HOS46	58.53011	159.9917	3.27258	38.12007	0	75.57697
imf2_HOS39	58.53011	159.9917	3.27258	38.12007	0	75.57697
imf2_HOS86	41.2348	115.7445	2.150066	25.49546	0	75.56972
imf2_HOS32	110.1454	301.2184	6.154085	71.71757	0	75.56234
imf2_HOS26	145.4778	397.9436	8.124859	94.70845	0	75.55438
imf2_HOS21	158.0293	432.3125	8.824681	102.8745	0	75.55184
imf2_HOS75	50.00359	140.3468	2.610579	30.96509	0	75.53731
imf2_HOS37	56.89768	155.7378	3.175058	37.03369	0	75.52941
imf2_HOS31	56.89768	155.7378	3.175058	37.03369	0	75.52941
imf2_HOS65	54.83593	153.9084	2.864452	33.98092	0	75.52147
imf2_HOS25	101.8742	278.9356	5.682056	66.29662	0	75.51853
imf2_HOS20	126.6607	346.8552	7.062836	82.41989	0	75.51342
imf3_HOS17	2.07E-14	6.41E-14	8.04E-16	9.14E-15	0	75.51258
imf1_HOS100	50.12037	116.0757	3.43112	40.91696	0	75.50044
imf2_HOS29	50.30967	137.8419	2.803361	32.73062	0	75.494
imf2_HOS24	50.30967	137.8419	2.803361	32.73062	0	75.494
imf2_HOS19	84.79475	232.3776	4.723382	55.15991	0	75.48638
imf2_HOS15	97.05229	265.988	5.405591	63.13127	0	75.48394
imf2_HOS18	39.84226	109.2428	2.217713	25.91189	0	75.46771
imf2_HOS22	39.84226	109.2428	2.217713	25.91189	0	75.46771
imf2_HOS14	61.81888	169.523	3.440292	40.20201	0	75.46296
imf3_HOS135	0.766972	2.419849	0.027742	0.309255	0	75.45563
imf2_HOS13	27.34303	75.01152	1.520784	17.77845	0	75.44853
imf2_HOS16	27.34303	75.01152	1.520784	17.77845	0	75.44853
imf2_HOS10	37.06696	101.6941	2.061424	24.10023	0	75.44627
imf2_HOS9	15.09291	41.42069	0.838989	9.811715	0	75.43504
imf2_HOS11	15.09291	41.42069	0.838989	9.811715	0	75.43504
imf2_HOS7	5.369358	14.73909	0.29837	3.490171	0	75.42643
imf2_HOS1	5.369358	14.73909	0.29837	3.490171	0	75.42643
imf2_HOS6	5.369358	14.73909	0.29837	3.490171	0	75.42643
imf1_HOS129	25.78783	59.30302	1.77306	21.27188	0	75.36358

imf2_HOS125	8.866119	25.19692	0.454346	5.388291	0	75.29717
imf1_HOS114	40.41662	93.28837	2.802104	33.59305	0	74.89418
imf1_HOS88	61.31661	142.3018	4.244848	50.76278	0	74.84331
imf1_HOS77	67.487	156.77	4.693665	56.19368	0	74.56951
imf2_HOS45	135.9866	377.2476	0.441478	107.2325	0	74.03347
imf2_HOS44	111.5887	309.3484	0.453271	87.99555	0	74.0042
imf1_HOS101	54.1295	125.4085	3.818806	45.97876	0	73.84767
imf2_HOS89	159.692	524.9185	-0.10466	77.45671	0	73.84321
imf2_HOS38	6.46E-14	1.55E-13	4.09E-15	5.38E-14	0	73.83428
imf2_HOS90	181.24	596.4729	-0.10192	87.81612	0	73.77042
imf2_HOS43	83.07532	231.3941	0.403886	65.43621	0	73.76033
imf3_HOS80	2.07E-14	6.55E-14	7.85E-16	9.73E-15	0	73.5584
imf1_HOS89	63.56008	147.5477	4.517296	54.48439	0	73.39367
imf1_HOS115	40.10679	92.68692	2.858392	34.57429	0	73.32671
imf1_HOS130	23.5611	54.28339	1.677862	20.3752	0	73.32018
imf1_HOS78	66.91617	155.4336	4.765837	57.51046	0	73.26271
imf2_HOS30	5.94E-14	1.45E-13	3.77E-15	5E-14	0	72.89338
imf2_HOS74	90.50111	298.2953	-0.07803	47.6047	0	72.7836
imf1_HOS102	51.61772	119.6941	3.723944	45.16237	0	72.57842
imf1_HOS45	62.57741	137.1166	4.628475	57.33662	0	72.47448
imf1_HOS53	59.87404	131.1505	4.430439	54.90452	0	72.44819
imf2_HOS135	2.293241	6.497207	0.14576	1.540081	0	72.43893
imf2_HOS42	54.51046	157.9824	0.291013	42.04875	0	72.43748
imf1_HOS62	52.25252	114.3388	3.871403	48.03431	0	72.36988
imf1_HOS90	58.00368	134.7006	4.202864	51.01657	0	72.3047
imf1_HOS72	41.07628	89.71519	3.049477	37.91864	0	72.24162
imf2_HOS91	191.9222	647.2184	-0.11459	94.23764	0	72.10805
imf2_HOS88	130.4289	439.3146	-0.12724	64.71508	0	72.10431
imf1_HOS83	28.29839	61.62925	2.106032	26.278	0	72.06782
imf2_HOS23	5.03E-14	1.24E-13	3.24E-15	4.25E-14	0	72.0364
imf1_HOS107	4.53E-14	1.22E-13	2.56E-15	3.49E-14	0	71.98928
imf1_HOS132	14.05751	31.21219	1.044943	12.89466	0	71.98731
imf1_HOS116	35.35871	81.75293	2.582963	31.49674	0	71.92651
imf1_HOS108	6.244696	13.46603	0.463788	5.861183	0	71.92374
imf1_HOS121	6.244696	13.46603	0.463788	5.861183	0	71.92374
imf1_HOS95	16.06289	34.83359	1.197431	15.01912	0	71.89668
imf1_HOS105	21.08633	46.78582	1.581666	19.4083	0	71.81728
imf1_HOS118	19.20246	42.58788	1.439755	17.68903	0	71.79905
imf2_HOS80	4.36E-14	1.26E-13	2.71E-15	2.9E-14	0	71.59843
imf1_HOS103	43.62144	101.0922	3.209678	39.17798	0	71.49339
imf1_HOS131	19.11095	43.93829	1.408105	17.30171	0	71.442
imf1_HOS91	46.58053	108.0246	3.433301	41.91653	0	71.38689
imf2_Wavelet Entropy	-4158654	6945320	-240085	4567309	0	71.29447
imf3_HOS135	-102.695	360.9524	0.227902	42.80729	0	70.97849
imf3_HOS136	-109.282	384.4481	0.252205	45.83	0	70.88547
imf3_HOS120	-104.836	369.4844	0.260575	43.35135	0	70.8769
imf1_HOS117	27.61499	63.46978	2.063002	25.3377	0	70.85424

imf1_HOS104	32.44005	74.56997	2.428296	29.80575	0	70.78503
imf3_HOS134	-93.5023	329.5191	0.184266	39.1646	0	70.75701
imf2_HOS55	25.21319	77.72631	1.252247	15.64165	0	70.58209
imf2_HOS64	24.10559	74.35376	1.197393	14.95753	0	70.54786
imf3_HOS119	-97.0447	343.3181	0.229625	40.60267	0	70.54771
imf2_HOS74	20.98976	64.86057	1.043206	13.03312	0	70.43655
imf1_HOS44	91.54	206.328	6.955285	86.24904	0	70.31481
imf1_HOS52	83.32541	187.7604	6.336452	78.61519	0	70.26414
imf3_HOS105	-97.0897	345.3298	0.263121	40.46409	0	70.25544
imf2_HOS85	16.44339	50.99063	0.818657	10.22554	0	70.21634
imf1_HOS61	68.38266	153.9919	5.208921	64.6954	0	70.16236
imf3_HOS133	-81.7847	290.6399	0.12629	34.988	0	70.05094
imf1_HOS71	49.37839	111.0626	3.770683	46.91485	0	70.0124
imf1_HOS82	29.6074	66.44632	2.267849	28.29206	0	69.82797
imf3_HOS118	-86.7323	309.4309	0.180007	37.24553	0	69.81512
imf2_HOS97	11.29528	35.24731	0.565149	7.047098	0	69.80749
imf1_HOS36	118.2596	270.1049	9.028826	111.8214	0	69.74558
imf1_HOS43	112.5448	257.0331	8.595302	106.4718	0	69.72588
imf1_HOS1	4.115649	9.57299	0.312257	3.842669	0	69.71402
imf1_HOS6	4.115649	9.57299	0.312257	3.842669	0	69.71402
imf1_HOS7	4.115649	9.57299	0.312257	3.842669	0	69.71402
imf1_HOS11	11.57537	26.91745	0.87843	10.8117	0	69.70612
imf1_HOS9	11.57537	26.91745	0.87843	10.8117	0	69.70612
imf1_HOS10	28.44906	66.13384	2.159582	26.58539	0	69.69557
imf1_HOS13	20.98901	48.7887	1.593387	19.61609	0	69.69321
imf1_HOS16	20.98901	48.7887	1.593387	19.61609	0	69.69321
imf1_HOS14	47.4975	110.3611	3.60718	44.41909	0	69.67941
imf1_HOS18	30.62164	71.1402	2.325877	28.64364	0	69.67386
imf1_HOS22	30.62164	71.1402	2.325877	28.64364	0	69.67386
imf1_HOS51	96.43844	220.1958	7.372501	91.37646	0	69.66604
imf1_HOS15	74.66778	173.3864	5.673761	69.89217	0	69.65999
imf1_HOS19	65.24786	151.502	4.958372	61.0827	0	69.65663
imf1_HOS24	38.73148	89.91324	2.944041	36.27342	0	69.64652
imf1_HOS29	38.73148	89.91324	2.944041	36.27342	0	69.64652
imf1_HOS94	12.30951	27.51828	0.945705	11.84365	0	69.64492
imf1_HOS106	12.30951	27.51828	0.945705	11.84365	0	69.64492
imf1_HOS20	97.62508	226.5043	7.423838	91.49532	0	69.63372
imf1_HOS25	78.54739	182.2158	5.974229	73.63805	0	69.62515
imf1_HOS31	43.90102	101.8114	3.340344	41.18264	0	69.60846
imf1_HOS37	43.90102	101.8114	3.340344	41.18264	0	69.60846
imf1_HOS21	122.0851	282.9401	9.292058	114.5886	0	69.60611
imf1_HOS26	112.4083	260.4956	8.556531	105.5253	0	69.60048
imf1_HOS32	85.1544	197.2943	6.484225	79.98469	0	69.58369
imf1_HOS35	133.638	307.294	10.20533	126.2213	0	69.58369
imf1_HOS27	134.6057	311.4585	10.25659	126.5827	0	69.57481
imf3_HOS104	-88.4556	317.0851	0.227238	37.90587	0	69.56498
imf1_HOS60	72.84209	166.2401	5.578025	69.20452	0	69.5641

imf1_HOS33	116.6897	269.9666	8.894045	109.7849	0	69.55959
imf1_HOS28	141.8134	327.366	10.81849	133.6422	0	69.55835
imf1_HOS39	45.29536	104.9017	3.451118	42.58554	0	69.5566
imf1_HOS46	45.29536	104.9017	3.451118	42.58554	0	69.5566
imf1_HOS42	119.742	275.3038	9.148628	113.1829	0	69.55502
imf1_HOS34	133.5211	308.203	10.18778	125.864	0	69.54815
imf1_HOS40	84.12665	194.5721	6.415909	79.22243	0	69.52924
imf1_HOS41	110.1566	254.2148	8.409728	103.9299	0	69.51778
imf1_HOS50	94.47071	217.1356	7.225004	89.43581	0	69.49721
imf1_HOS48	42.79494	98.92432	3.266683	40.3576	0	69.48548
imf1_HOS56	42.79494	98.92432	3.266683	40.3576	0	69.48548
imf3_HOS12	2.23E-14	7.69E-14	7.9E-16	9.52E-15	0	69.47289
imf1_HOS49	75.94882	175.1955	5.803628	71.76238	0	69.46775
imf1_HOS70	45.92783	104.7266	3.525535	43.80693	0	69.41924
imf1_HOS59	62.35298	143.2329	4.775876	59.17331	0	69.41061
imf1_HOS67	36.98736	85.25645	2.830151	35.02379	0	69.39915
imf1_HOS58	36.98736	85.25645	2.830151	35.02379	0	69.39915
imf1_HOS79	29.00765	66.55847	2.226108	27.61869	0	69.30511
imf1_HOS69	29.00765	66.55847	2.226108	27.61869	0	69.30511
imf3_HOS91	-86.4735	311.7181	0.261748	36.85273	0	69.28344
imf1_HOS81	20.29234	46.18604	1.562267	19.45341	0	69.25594
imf1_HOS92	20.29234	46.18604	1.562267	19.45341	0	69.25594
imf2_HOS103	157.4893	555.5629	-0.19082	80.4698	0	69.02541
imf2_HOS110	6.455404	20.38309	0.327829	4.060576	0	68.99323
imf2_HOS17	4.37E-14	1.27E-13	2.72E-15	3.23E-14	0	68.99313
imf4_HOS123	0.118995	0.366668	0.005809	0.08203	0	68.78953
imf2_HOS104	176.13	623.6471	-0.18515	91.03064	0	68.68327
imf4_HOS109	0.395561	1.226445	0.019114	0.273427	0	68.46561
imf3_HOS132	-67.7274	245.543	0.060725	30.45804	0	68.41058
imf3_HOS117	-74.0162	268.7538	0.117926	33.41004	0	68.33779
imf4_HOS96	0.796937	2.477668	0.038355	0.551235	0	68.33174
imf3_HOS103	-77.4289	281.6533	0.174176	34.76198	0	68.3108
imf3_HOS90	-77.4234	282.2099	0.222759	34.36254	0	68.30883
imf4_HOS84	1.261216	3.926846	0.060578	0.872583	0	68.26164
imf1_HOS8	5.56E-14	1.65E-13	3.1E-15	4.21E-14	0	68.23978
imf4_HOS73	1.709953	5.328506	0.082039	1.183171	0	68.22162
imf4_HOS63	2.063797	6.434211	0.098954	1.428078	0	68.19916
imf4_HOS54	2.258601	7.043076	0.108265	1.562909	0	68.18896
imf3_HOS78	-73.603	269.3722	0.257745	32.26996	0	68.18638
imf3_HOS93	2.01E-14	7.03E-14	7.28E-16	9.24E-15	0	67.65186
imf2_HOS87	96.94339	348.6488	-0.17239	52.23477	0	67.41926
imf2_HOS102	130.2115	472.4476	-0.2106	67.83547	0	67.21748
imf4_HOS134	0.260128	0.815819	0.01281	0.186401	0	67.15771
imf3_HOS66	-59.2319	220.1969	0.250486	26.67337	0	67.10176
imf3_HOS77	-64.6036	239.4681	0.216932	29.70357	0	67.07542
imf4_HOS120	0.317243	0.996813	0.015546	0.227817	0	67.04388
imf4_HOS47	8.92E-15	2.81E-14	4.52E-16	6.29E-15	0	67.04214

imf2_HOS124	2.733901	8.85591	0.146683	1.768162	0	67.0134
imf2_HOS12	4.49E-14	1.43E-13	2.62E-15	3.04E-14	0	66.98024
imf4_HOS57	8.01E-15	2.54E-14	4.05E-16	5.64E-15	0	66.85342
imf4_HOS38	9.14E-15	2.91E-14	4.63E-16	6.44E-15	0	66.65254
imf1_HOS122	4.14E-14	1.22E-13	2.46E-15	3.37E-14	0	66.56809
imf3_HOS89	-66.1464	246.3	0.16859	31.32802	0	66.53871
imf2_HOS105	183.3975	670.6627	-0.19127	98.03144	0	66.49006
imf2_HOS5	6.06E-14	1.92E-13	3.42E-15	4.28E-14	0	66.42745
imf2_HOS3	6.39E-14	2.01E-13	3.61E-15	4.61E-14	0	66.41907
imf2_HOS2	6.05E-14	1.92E-13	3.42E-15	4.31E-14	0	66.27917
imf2_HOS4	6.07E-14	1.94E-13	3.42E-15	4.26E-14	0	66.27824
imf3_HOS65	-50.7614	190.6666	0.208322	23.87195	0	66.17703
imf4_HOS68	6.72E-15	2.14E-14	3.41E-16	4.82E-15	0	66.17036
imf4_HOS135	0.168594	0.546988	0.007887	0.117725	0	66.15645
imf4_HOS30	8.51E-15	2.73E-14	4.28E-16	6.03E-15	0	66.09606
imf4_HOS124	0.279692	0.901714	0.013232	0.201058	0	65.91179
imf3_HOS102	-64.1637	240.5136	0.11098	31.21249	0	65.8951
imf4_HOS136	0.268033	0.860163	0.012716	0.195224	0	65.88021
imf4_HOS110	0.692654	2.229674	0.032894	0.5023	0	65.81224
imf4_HOS97	1.223907	3.937985	0.058226	0.890293	0	65.77155
imf4_HOS85	1.78637	5.746573	0.085066	1.30135	0	65.75089
imf4_HOS74	2.2819	7.339899	0.108721	1.663632	0	65.73954
imf4_HOS64	2.621081	8.430481	0.124917	1.911661	0	65.73372
imf4_HOS55	2.741583	8.817933	0.130671	1.999788	0	65.73191
imf1_HOS4	6.21E-14	1.91E-13	3.54E-15	4.89E-14	0	65.69467
imf1_HOS5	6.21E-14	1.91E-13	3.54E-15	4.89E-14	0	65.66386
imf3_HOS55	-44.1952	168.3282	0.236985	20.53184	0	65.52288
imf1_HOS2	6.21E-14	1.91E-13	3.53E-15	4.91E-14	0	65.51532
imf3_HOS8	2.63E-14	9.64E-14	8.93E-16	1.19E-14	0	65.34759
imf3_HOS54	-36.7095	139.9841	0.193279	17.34257	0	65.33317
imf4_HOS125	0.957249	3.078153	0.046035	0.713978	0	65.2954
imf1_HOS3	6.55E-14	2.02E-13	3.72E-15	5.2E-14	0	65.27119
imf3_HOS116	-59.1213	223.2844	0.050945	29.34082	0	65.25112
imf4_HOS126	1.768148	5.689402	0.085375	1.326579	0	65.14005
imf4_HOS133	0.865001	2.780623	0.042306	0.650378	0	65.10099
imf4_HOS127	2.502994	8.056285	0.121089	1.881867	0	65.08001
imf4_HOS80	5.6E-15	1.82E-14	2.77E-16	4.12E-15	0	65.06852
imf4_HOS128	2.98903	9.621863	0.144778	2.249583	0	65.05079
imf4_HOS129	3.12175	10.04943	0.151354	2.350811	0	65.03513
imf4_HOS132	1.610624	5.182683	0.078419	1.213268	0	65.03415
imf4_HOS130	2.882424	9.27867	0.139886	2.171313	0	65.02716
imf4_HOS131	2.33599	7.518812	0.113506	1.759958	0	65.02538
imf4_HOS108	0.616175	1.984625	0.030144	0.465492	0	64.91958
imf4_HOS121	0.616175	1.984625	0.030144	0.465492	0	64.91958
imf4_HOS45	6.981358	22.49789	0.34017	5.277359	0	64.89715
imf4_HOS53	6.670668	21.49665	0.32505	5.042548	0	64.89682
imf4_HOS95	1.68815	5.439391	0.082435	1.276116	0	64.89639

imf4_HOS62	5.795846	18.67741	0.282475	4.381356	0	64.89587
imf4_HOS72	4.516821	14.55553	0.220215	3.414599	0	64.89452
imf4_HOS83	3.063342	9.871368	0.149439	2.315856	0	64.89358
imf3_HOS76	-53.5714	204.0668	0.163368	26.65737	0	64.87973
imf4_HOS111	2.060644	6.655228	0.099444	1.553579	0	64.87842
imf2_HOS8	5.25E-14	1.74E-13	2.97E-15	3.6E-14	0	64.74878
imf4_HOS98	3.344555	10.82128	0.161624	2.531003	0	64.72052
imf4_HOS119	1.172984	3.79005	0.057368	0.888987	0	64.71405
imf4_HOS23	7.24E-15	2.34E-14	3.65E-16	5.48E-15	0	64.68041
imf4_HOS112	3.499724	11.32206	0.169488	2.654367	0	64.6758
imf4_HOS86	4.589444	14.86242	0.221933	3.479121	0	64.64428
imf3_HOS131	-51.6256	196.6685	-0.00483	25.88989	0	64.61404
imf4_HOS75	5.572932	18.05575	0.269586	4.228359	0	64.60528
imf4_HOS113	4.660631	15.0875	0.226069	3.542038	0	64.60234
imf4_HOS65	6.114936	19.81582	0.29585	4.64133	0	64.58839
imf4_HOS118	2.347471	7.597226	0.114428	1.784998	0	64.58837
imf4_HOS114	5.292525	17.13783	0.256971	4.025897	0	64.5693
imf4_HOS117	3.600705	11.65829	0.175251	2.739986	0	64.55899
imf4_HOS115	5.281014	17.1022	0.256607	4.01882	0	64.55443
imf4_HOS116	4.661716	15.09619	0.226682	3.547975	0	64.55102
imf4_HOS99	5.344023	17.32481	0.259087	4.06802	0	64.50725
imf4_HOS105	2.612224	8.46384	0.127355	1.989775	0	64.50198
imf3_HOS5	3.04E-14	1.13E-13	1.03E-15	1.43E-14	0	64.48509
imf4_HOS94	1.477731	4.790895	0.07217	1.127466	0	64.43715
imf4_HOS106	1.477731	4.790895	0.07217	1.127466	0	64.43715
imf4_HOS100	6.768208	21.95722	0.328601	5.161956	0	64.43456
imf4_HOS104	4.306147	13.96545	0.209667	3.28509	0	64.43428
imf3_HOS107	2.05E-14	7.62E-14	7E-16	9.33E-15	0	64.43218
imf4_HOS87	6.973785	22.63076	0.338273	5.31731	0	64.42945
imf4_HOS82	3.635342	11.78912	0.177435	2.774901	0	64.41866
imf4_HOS71	6.135963	19.90042	0.299369	4.68442	0	64.41233
imf4_HOS61	8.554514	27.74555	0.417264	6.531262	0	64.40995
imf4_HOS52	10.46204	33.93302	0.510233	7.987848	0	64.40905
imf4_HOS44	11.51226	37.33965	0.561413	8.789792	0	64.40874
imf4_HOS103	5.895139	19.12683	0.286815	4.499952	0	64.40649
imf4_HOS101	7.343811	23.83058	0.356849	5.605193	0	64.40589
imf4_HOS102	7.006279	22.73577	0.340666	5.348838	0	64.39831
imf4_HOS76	8.091187	26.26921	0.392568	6.173932	0	64.39303
imf4_HOS66	8.488471	27.56292	0.411873	6.478514	0	64.38219
imf4_HOS91	6.335548	20.56573	0.308283	4.839635	0	64.37021
imf3_HOS4	3.04E-14	1.13E-13	1.03E-15	1.42E-14	0	64.36304
imf4_HOS88	8.439315	27.40491	0.409898	6.446123	0	64.36107
imf4_HOS90	7.961972	25.85605	0.387225	6.08515	0	64.34321
imf4_HOS89	8.755315	28.43586	0.425571	6.691449	0	64.33962
imf4_HOS77	9.361957	30.41287	0.454785	7.1551	0	64.33154
imf4_HOS78	9.257945	30.07578	0.450042	7.07821	0	64.32104
imf4_HOS92	2.611501	8.485597	0.127442	1.998844	0	64.27781

imf4_HOS81	2.611501	8.485597	0.127442	1.998844	0	64.27781
imf4_HOS70	5.975865	19.42136	0.291542	4.575339	0	64.26385
imf4_HOS60	9.536947	30.99774	0.465186	7.302913	0	64.25731
imf4_HOS51	12.67225	41.19041	0.618042	9.704505	0	64.25403
imf4_HOS43	14.8171	48.16329	0.7226	11.34746	0	64.25245
imf4_HOS36	15.57887	50.63982	0.759733	11.93098	0	64.25198
imf4_HOS69	3.857557	12.54809	0.188171	2.95699	0	64.20151
imf4_HOS79	3.857557	12.54809	0.188171	2.95699	0	64.20151
imf4_HOS59	8.346594	27.15435	0.407084	6.399422	0	64.19114
imf4_HOS50	12.6957	41.30683	0.619135	9.735067	0	64.1856
imf4_HOS42	16.12846	52.478	0.786491	12.36809	0	64.18263
imf4_HOS35	18.01906	58.63066	0.878657	13.81828	0	64.18133
imf4_HOS58	5.013091	16.31722	0.244476	3.846016	0	64.15758
imf4_HOS67	5.013091	16.31722	0.244476	3.846016	0	64.15758
imf4_HOS49	10.3383	33.65413	0.504127	7.932718	0	64.14988
imf4_HOS41	15.03461	48.9451	0.733088	11.53728	0	64.14552
imf4_HOS34	18.24989	59.41438	0.889834	14.00527	0	64.14325
imf4_HOS28	19.3922	63.13396	0.94552	14.88211	0	64.14255
imf4_HOS48	5.871964	19.1206	0.286313	4.507354	0	64.12947
imf4_HOS56	5.871964	19.1206	0.286313	4.507354	0	64.12947
imf4_HOS40	11.57782	37.70348	0.564494	8.888199	0	64.12374
imf4_HOS33	16.08805	52.39366	0.784368	12.35146	0	64.12049
imf4_HOS27	18.57377	60.49018	0.905542	14.26026	0	64.11901
imf4_HOS39	6.268031	20.41604	0.305589	4.813123	0	64.11027
imf4_HOS46	6.268031	20.41604	0.305589	4.813123	0	64.11027
imf4_HOS32	11.80892	38.46605	0.575706	9.068623	0	64.10604
imf4_HOS26	15.6069	50.83917	0.760848	11.98579	0	64.10377
imf4_HOS21	16.9569	55.23738	0.826656	13.02275	0	64.10305
imf4_HOS37	6.112601	19.91378	0.297986	4.694973	0	64.09662
imf4_HOS31	6.112601	19.91378	0.297986	4.694973	0	64.09662
imf4_HOS25	10.95307	35.68479	0.533944	8.413333	0	64.09356
imf4_HOS20	13.62311	44.38461	0.664096	10.46454	0	64.09214
imf4_HOS24	5.417432	17.65163	0.264081	4.161796	0	64.08669
imf4_HOS29	5.417432	17.65163	0.264081	4.161796	0	64.08669
imf4_HOS19	9.135614	29.76751	0.445323	7.018466	0	64.08459
imf4_HOS15	10.45799	34.07667	0.50978	8.034486	0	64.08392
imf4_HOS18	4.297631	14.00448	0.209485	3.301985	0	64.07943
imf4_HOS22	4.297631	14.00448	0.209485	3.301985	0	64.07943
imf4_HOS14	6.670278	21.73653	0.325135	5.125076	0	64.07813
imf4_HOS16	2.953053	9.62372	0.14394	2.26913	0	64.07418
imf4_HOS13	2.953053	9.62372	0.14394	2.26913	0	64.07418
imf4_HOS10	4.00383	13.04822	0.195157	3.076583	0	64.07356
imf4_HOS9	1.631451	5.317033	0.07952	1.253694	0	64.07052
imf4_HOS11	1.631451	5.317033	0.07952	1.253694	0	64.07052
imf4_HOS1	0.580714	1.89266	0.028305	0.446271	0	64.0682
imf4_HOS6	0.580714	1.89266	0.028305	0.446271	0	64.0682
imf4_HOS7	0.580714	1.89266	0.028305	0.446271	0	64.0682

imf3_HOS3	3.2E-14	1.2E-13	1.09E-15	1.51E-14	0	63.95946
imf3_HOS2	3.03E-14	1.13E-13	1.03E-15	1.43E-14	0	63.92807
imf3_HOS64	-40.4674	156.4287	0.156401	20.6704	0	63.90127
imf3_HOS53	-27.6163	107.2936	0.143582	13.8104	0	63.85557
imf1_Wavelet Entropy	-1952064	2914850	-129034	2495492	0	63.8269
imf2_HOS61	47.35592	175.1215	-0.11467	31.37052	0	63.64258
imf2_HOS118	149.0798	571.1975	-0.25928	87.80511	0	63.038
imf3_HOS88	-52.8321	206.0962	0.106896	27.98182	0	62.99915
imf3_HOS121	103.3734	413.2406	-0.10467	43.48597	0	62.98375
imf3_HOS122	96.75217	387.1994	-0.09386	40.21151	0	62.97538
imf2_HOS93	4.09E-14	1.33E-13	2.5E-15	3.29E-14	0	62.51338
imf3_HOS123	87.06442	351.3023	-0.09674	36.41651	0	62.47786
imf2_HOS119	164.6317	635.7786	-0.26102	99.612	0	62.34875
imf2_HOS101	97.5596	382.586	-0.24531	55.70434	0	62.12748
imf2_HOS73	57.82909	222.1077	-0.17274	38.13048	0	61.80868
imf3_HOS106	99.14573	407.5272	-0.07767	40.41503	0	61.50914
imf2_HOS117	124.3515	490.7754	-0.26823	73.97361	0	61.40466
imf3_HOS122	2.06E-14	8.08E-14	6.83E-16	9.35E-15	0	61.36086
imf3_HOS124	74.49297	306.6279	-0.10971	32.20587	0	61.2054
imf5_Tsallis Entropy	-281916	963360.3	-24390.2	196117.2	0	61.03762
imf3_HOS107	91.22442	378.1193	-0.07176	37.39776	0	61.00806
imf3_HOS101	-48.9229	196.6857	0.04573	27.5656	0	60.81732
imf2_HOS3	-243.527	961.9681	1.323665	167.3839	0	60.09367
imf3_HOS75	-40.7265	165.9247	0.105196	23.41668	0	60.05827
imf2_HOS36	94.01377	288.4283	0.608235	104.4788	0	59.97557
imf3_HOS108	80.26682	339.0817	-0.0797	33.92311	0	59.82425
imf2_HOS120	168.748	679.2251	-0.27251	108.2491	0	59.65867
imf3_HOS92	91.8363	392.3289	-0.04753	37.04038	0	59.36006
imf2_HOS5	-206.802	819.7129	1.034786	150.1458	0	59.26364
imf4_HOS93	4.9E-15	1.69E-14	2.39E-16	4.28E-15	0	59.11684
imf2_HOS6	-199.796	811.9798	1.202846	133.1292	0	59.06787
imf3_HOS45	-29.3429	124.5014	0.212531	15.81481	0	58.67519
imf3_HOS125	59.39312	255.2993	-0.12697	27.7915	0	58.481
imf3_HOS93	82.98955	359.9053	-0.04635	34.27263	0	58.44452
imf3_HOS115	-42.3844	177.0231	-0.01299	25.43655	0	58.27514
imf4_HOS17	5.87E-15	2.01E-14	3.02E-16	5.42E-15	0	58.17843
imf3_HOS44	-23.2478	100.2158	0.166836	12.49542	0	57.86456
imf3_HOS63	-28.5989	120.7804	0.103202	17.40674	0	57.83368
imf2_HOS1	-271.009	1090.41	1.394798	210.1846	0	57.76321
imf2_HOS2	-240.423	955.221	1.126947	196.147	0	57.61856
imf3_HOS109	66.55947	292.0996	-0.09619	30.15136	0	57.48165
imf3_HOS52	-17.2021	73.52816	0.096466	10.30203	0	57.47169
imf2_HOS9	-159.665	666.2345	0.92915	112.7551	0	57.20045
imf3_HOS79	81.9719	366.2307	-0.01567	33.21075	0	56.88154
imf2_HOS8	-162.05	660.3197	0.715172	129.579	0	56.76698
imf3_HOS94	71.23499	318.4604	-0.0581	31.11529	0	56.61337
imf2_HOS86	62.76177	265.3727	-0.24034	43.94653	0	56.55311

imf2_HOS116	93.40076	402.1934	-0.28791	60.38118	0	56.36422
imf1_MMSE7	0.676156	0.267604	0.527762	0.231061	0	56.18392
imf2_HOS107	4.1E-14	1.5E-13	2.39E-15	3.63E-14	0	56.02991
imf2_HOS134	135.6392	574.7013	-0.32934	99.68441	0	55.89068
imf3_HOS80	72.67695	331.3535	-0.01867	30.62643	0	55.67977
imf2_HOS4	-197.814	796.7273	0.799398	177.246	0	55.63763
imf1_MMSE6	0.642019	0.28284	0.490624	0.237379	0	55.55212
imf1_MMSE5	0.593218	0.2723	0.450875	0.223111	0	55.35786
imf3_HOS87	-37.7758	165.9064	0.046087	24.69442	0	55.22988
imf4_HOS107	4.62E-15	1.66E-14	2.25E-16	4.57E-15	0	55.13059
imf3_HOS130	-33.8863	149.141	-0.06306	21.80582	0	55.08289
imf2_HOS135	148.0677	635.2492	-0.35168	113.1351	0	54.91664
imf2_HOS41	29.2902	119.9082	0.122069	25.99274	0	54.6711
imf1_MMSE4	0.533563	0.24042	0.410767	0.195432	0	54.44833
imf2_HOS133	113.8705	497.6909	-0.31521	84.25476	0	54.44086
imf3_HOS67	70.30001	328.7343	0.016423	28.81733	0	54.42869
imf2_HOS35	67.55447	231.7443	0.58359	81.53501	0	54.2941
imf3_HOS43	-15.772	72.64751	0.11989	9.054836	0	54.17929
imf2_HOS13	-115.618	511.6078	0.64212	90.7639	0	53.45367
imf2_HOS10	-144.284	646.4997	1.080259	108.9666	0	53.39538
imf3_HOS81	60.67883	288.3693	-0.03271	27.71439	0	53.30005
imf3_HOS95	56.94327	270.2791	-0.07602	27.78592	0	53.15749
imf3_HOS68	61.08876	292.0933	0.009762	26.28629	0	53.15481
imf1_MMSE8	0.673453	0.225754	0.546562	0.211907	0	52.99903
imf3_HOS110	50.54873	240.0662	-0.11411	26.37691	0	52.89597
imf3_HOS126	42.26433	200.8203	-0.14149	23.54877	0	52.62023
imf2_HOS122	4.1E-14	1.6E-13	2.29E-15	3.91E-14	0	52.59911
imf3_HOS56	57.69716	280.5129	0.046769	23.92188	0	52.39787
imf3_HOS39	19.70082	94.34127	0.050304	9.92441	0	52.39217
imf2_HOS12	-115.662	499.4624	0.401071	109.0422	0	52.12789
imf3_HOS38	27.28693	131.9357	0.067642	13.21232	0	52.08334
imf5_HOS23	1.66E-15	6.8E-15	7.93E-17	1.49E-15	0	52.05234
imf2_HOS136	149.532	674.8263	-0.37903	123.9824	0	51.89203
imf2_HOS7	-149.909	629.1633	0.457987	156.5528	0	51.59652
imf1_T1	11.16445	3.307546	9.413046	2.990452	0	51.57628
imf5_HOS30	1.97E-15	8.14E-15	9.46E-17	1.8E-15	0	51.48412
imf4_HOS122	4.4E-15	1.67E-14	2.21E-16	4.76E-15	0	51.44783
imf3_HOS57	49.10144	242.8734	0.036505	21.25299	0	51.43429
imf4_HOS12	5.24E-15	1.88E-14	2.8E-16	6.14E-15	0	51.41936
imf5_HOS17	1.33E-15	5.58E-15	6.25E-17	1.18E-15	0	51.36052
imf3_HOS47	37.57578	186.5295	0.057641	16.09618	0	51.24898
imf5_HOS38	2.13E-15	8.82E-15	1.02E-16	1.96E-15	0	51.23299
imf3_HOS46	45.07378	224.1885	0.072245	19.09702	0	51.18043
imf2_HOS100	62.99384	296.8827	-0.2941	47.57813	0	51.0612
imf5_HOS47	2.08E-15	8.66E-15	1E-16	1.95E-15	0	50.89974
imf1_MMSE3	0.465487	0.195244	0.370747	0.162263	0	50.77742
imf5_HOS57	1.86E-15	7.76E-15	9.09E-17	1.75E-15	0	50.56701

imf5_HOS68	1.54E-15	6.5E-15	7.6E-17	1.41E-15	0	50.43808
imf3_HOS69	49.42737	248.4657	-0.00524	23.476	0	50.42333
imf2_HOS50	31.10353	142.533	-0.08443	28.01135	0	50.37504
imf5_HOS80	1.24E-15	5.34E-15	5.97E-17	1.1E-15	0	50.36913
imf3_HOS37	33.28645	167.0977	0.088138	16.27225	0	50.25392
imf2_LAM	0.569025	0.085041	0.629313	0.109752	0	50.1737
imf3_HOS48	28.19193	144.2813	0.041794	12.77632	0	49.64143
imf2_HOS132	85.33251	411.1957	-0.30931	68.46476	0	49.56633
imf3_HOS100	-32.0786	156.3057	-0.0135	24.28649	0	49.38052
imf1_Sample Entropy	0.747823	0.161637	0.664589	0.148901	0	49.35268
imf2_HOS14	-103.666	503.904	0.838703	86.43103	0	49.09438
imf3_HOS58	38.33242	199.4498	0.021222	18.32271	0	48.76787
imf3_HOS82	46.40767	240.1166	-0.04993	24.74974	0	48.74216
imf3_HOS74	-26.3927	130.9732	0.050964	20.42329	0	48.57301
imf2_T1	16.55904	1.846838	15.13386	2.724364	0	48.19623
imf5_HOS123	0.021447	0.108036	0.000854	0.013688	0	47.12702
imf3_HOS40	11.03682	58.17035	0.044004	6.768942	0	47.12559
imf5_HOS109	0.072293	0.364698	0.002872	0.046136	0	47.0699
imf5_HOS96	0.146397	0.739089	0.005812	0.093434	0	47.03927
imf5_HOS84	0.232271	1.173138	0.009217	0.148252	0	47.02158
imf5_HOS73	0.315353	1.593172	0.01251	0.20129	0	47.01097
imf5_HOS63	0.380902	1.924615	0.015109	0.243137	0	47.00486
imf5_HOS54	0.417001	2.107155	0.01654	0.266183	0	47.00205
imf2_HOS18	-73.6636	364.4881	0.366859	70.66235	0	46.90314
imf4_HOS3	6.58E-15	2.54E-14	3.53E-16	8.68E-15	0	46.73082
imf5_HOS120	0.059225	0.300702	0.002376	0.03833	0	46.70989
imf5_HOS134	0.048224	0.244868	0.001937	0.03122	0	46.7029
imf5_HOS136	0.052739	0.268479	0.002108	0.034325	0	46.57863
imf4_HOS8	5.53E-15	2.13E-14	2.97E-16	7.34E-15	0	46.57808
imf3_HOS96	40.62655	219.0582	-0.09209	24.65505	0	46.49403
imf4_HOS4	6.26E-15	2.41E-14	3.37E-16	8.36E-15	0	46.49014
imf5_HOS125	0.189018	0.963671	0.007597	0.123791	0	46.47414
imf5_HOS126	0.349101	1.780295	0.014055	0.229082	0	46.44964
imf5_HOS110	0.135691	0.693296	0.005415	0.088106	0	46.44239
imf5_HOS97	0.239824	1.225278	0.009577	0.155811	0	46.44063
imf5_HOS85	0.350045	1.788419	0.013983	0.227488	0	46.43825
imf5_HOS74	0.447138	2.284507	0.017865	0.290635	0	46.43653
imf5_HOS127	0.493923	2.519311	0.0199	0.324369	0	46.43638
imf5_HOS64	0.513592	2.624055	0.020522	0.333857	0	46.43553
imf5_HOS55	0.537201	2.744685	0.021466	0.349213	0	46.4352
imf4_HOS5	6.25E-15	2.42E-14	3.36E-16	8.34E-15	0	46.43052
imf5_HOS124	0.054692	0.2796	0.002179	0.035465	0	46.42926
imf5_HOS128	0.589498	3.007171	0.023761	0.387296	0	46.42828
imf5_HOS129	0.615286	3.139014	0.024808	0.404345	0	46.42246
imf4_HOS2	6.23E-15	2.42E-14	3.35E-16	8.29E-15	0	46.41817
imf5_HOS130	0.567665	2.896318	0.022895	0.373123	0	46.41728
imf5_HOS131	0.459504	2.344729	0.018539	0.302081	0	46.41108

imf5_HOS132	0.316117	1.6134	0.01276	0.207853	0	46.40066
imf5_HOS133	0.168742	0.861663	0.006817	0.110949	0	46.378
imf5_HOS45	1.3727	7.008956	0.055448	0.903688	0	46.3754
imf5_HOS111	0.409134	2.089752	0.016479	0.268897	0	46.37538
imf5_HOS53	1.311538	6.696711	0.052978	0.863432	0	46.37502
imf5_HOS62	1.139333	5.81756	0.046025	0.750087	0	46.37385
imf5_HOS72	0.8876	4.532369	0.035859	0.584391	0	46.3717
imf5_HOS83	0.601612	3.072223	0.024309	0.396131	0	46.36824
imf5_HOS95	0.331165	1.691319	0.013385	0.218079	0	46.36298
imf5_HOS108	0.120583	0.615921	0.004876	0.079411	0	46.35627
imf5_HOS121	0.120583	0.615921	0.004876	0.079411	0	46.35627
imf5_HOS112	0.695407	3.554205	0.028056	0.458051	0	46.33468
imf5_HOS98	0.66526	3.400751	0.026815	0.437792	0	46.33361
imf5_HOS113	0.925928	4.733812	0.037382	0.610389	0	46.31671
imf5_HOS86	0.91363	4.672359	0.03684	0.601605	0	46.31245
imf5_HOS114	1.05107	5.374483	0.04245	0.693164	0	46.30712
imf5_HOS75	1.109865	5.677178	0.044761	0.731047	0	46.30135
imf5_HOS115	1.048245	5.360578	0.042347	0.691457	0	46.3013
imf5_HOS116	0.924649	4.728865	0.037362	0.610008	0	46.29726
imf5_HOS65	1.218017	6.231003	0.049127	0.802391	0	46.29648
imf5_HOS117	0.713378	3.648622	0.028832	0.470656	0	46.29373
imf5_HOS118	0.464054	2.373682	0.018761	0.306148	0	46.28921
imf5_HOS99	1.064136	5.4437	0.042963	0.701842	0	46.28917
imf5_HOS119	0.230448	1.178947	0.009321	0.151938	0	46.28517
imf5_HOS100	1.347629	6.896038	0.054444	0.889517	0	46.27132
imf5_HOS87	1.389974	7.113697	0.056137	0.917289	0	46.26734
imf5_HOS105	0.51711	2.646261	0.020912	0.341363	0	46.26689
imf5_HOS101	1.461711	7.48087	0.059072	0.965161	0	46.26302
imf5_HOS104	0.854749	4.374582	0.03456	0.564442	0	46.26081
imf5_HOS102	1.39376	7.133526	0.056338	0.920441	0	46.25934
imf5_HOS103	1.171754	5.997284	0.047372	0.773855	0	46.25869
imf5_HOS76	1.613386	8.258835	0.06517	1.065019	0	46.25692
imf5_HOS135	0.032706	0.168024	0.001295	0.021133	0	46.25536
imf5_HOS66	1.69282	8.666008	0.068381	1.117546	0	46.25379
imf5_HOS44	2.282238	11.68137	0.092334	1.507859	0	46.25373
imf5_HOS52	2.073864	10.6149	0.083905	1.370197	0	46.25342
imf5_HOS61	1.69543	8.678011	0.068597	1.120181	0	46.25281
imf5_HOS71	1.215699	6.222619	0.04919	0.803232	0	46.25196
imf5_HOS94	0.292305	1.496184	0.01183	0.19312	0	46.25174
imf5_HOS106	0.292305	1.496184	0.01183	0.19312	0	46.25174
imf5_HOS82	0.719852	3.684658	0.02913	0.47562	0	46.25114
imf5_HOS88	1.681956	8.610438	0.06797	1.110803	0	46.25076
imf5_HOS91	1.259952	6.449993	0.050944	0.832323	0	46.24881
imf5_HOS89	1.744207	8.93	0.070507	1.152256	0	46.24459
imf5_HOS90	1.58509	8.115298	0.064085	1.047219	0	46.24416
imf5_HOS77	1.866539	9.557011	0.075438	1.232976	0	46.24236
imf5_HOS78	1.844796	9.446003	0.074578	1.218873	0	46.23936

imf5_HOS81	0.518519	2.65598	0.020989	0.342915	0	46.21673
imf5_HOS92	0.518519	2.65598	0.020989	0.342915	0	46.21673
imf5_HOS70	1.187213	6.081451	0.048056	0.785196	0	46.21473
imf5_HOS60	1.895332	9.708899	0.076716	1.253556	0	46.2141
imf5_HOS51	2.518937	12.9034	0.101955	1.666015	0	46.21391
imf5_HOS43	2.945598	15.08902	0.119222	1.948211	0	46.21387
imf5_HOS36	3.097141	15.86531	0.125355	2.048442	0	46.21386
imf5_HOS69	0.767349	3.931946	0.031064	0.507704	0	46.19961
imf5_HOS79	0.767349	3.931946	0.031064	0.507704	0	46.19961
imf5_HOS59	1.660915	8.511008	0.067237	1.098978	0	46.19759
imf5_HOS50	2.526916	12.94892	0.102293	1.672027	0	46.19663
imf5_HOS42	3.210578	16.45245	0.129967	2.124422	0	46.19615
imf5_HOS35	3.58714	18.3822	0.14521	2.373603	0	46.19595
imf5_HOS67	0.998291	5.116392	0.040415	0.66067	0	46.18954
imf5_HOS58	0.998291	5.116392	0.040415	0.66067	0	46.18954
imf5_HOS49	2.059234	10.55427	0.083365	1.362861	0	46.18783
imf5_HOS41	2.995112	15.35128	0.121252	1.982297	0	46.18691
imf5_HOS34	3.635936	18.63598	0.147194	2.406449	0	46.18644
imf5_HOS28	3.86362	19.80303	0.156412	2.557151	0	46.1863
imf5_HOS48	1.170142	5.997994	0.047373	0.774525	0	46.18297
imf5_HOS56	1.170142	5.997994	0.047373	0.774525	0	46.18297
imf5_HOS40	2.307568	11.82863	0.093421	1.527443	0	46.18162
imf5_HOS33	3.20682	16.43848	0.129826	2.122719	0	46.18086
imf5_HOS27	3.70247	18.97937	0.149892	2.450828	0	46.18052
imf5_HOS46	1.249669	6.406262	0.050593	0.827252	0	46.1784
imf5_HOS39	1.249669	6.406262	0.050593	0.827252	0	46.1784
imf5_HOS32	2.354642	12.07103	0.095328	1.558755	0	46.17737
imf5_HOS26	3.112143	15.95453	0.125995	2.06024	0	46.17682
imf5_HOS21	3.381416	17.33504	0.136896	2.238508	0	46.17664
imf5_HOS31	1.219098	6.249985	0.049355	0.807075	0	46.17511
imf5_HOS37	1.219098	6.249985	0.049355	0.807075	0	46.17511
imf5_HOS25	2.18466	11.20035	0.088446	1.446327	0	46.17435
imf5_HOS20	2.717321	13.9313	0.110011	1.798983	0	46.174
imf5_HOS29	1.080723	5.540862	0.043753	0.715506	0	46.17268
imf5_HOS24	1.080723	5.540862	0.043753	0.715506	0	46.17268
imf5_HOS19	1.822562	9.344377	0.073787	1.206663	0	46.17216
imf5_HOS15	2.086414	10.6972	0.084469	1.381357	0	46.17199
imf5_HOS18	0.85749	4.396521	0.034716	0.567734	0	46.17089
imf5_HOS22	0.85749	4.396521	0.034716	0.567734	0	46.17089
imf5_HOS14	1.33094	6.824039	0.053884	0.881206	0	46.17056
imf5_HOS13	0.58929	3.021489	0.023858	0.390173	0	46.16958
imf5_HOS16	0.58929	3.021489	0.023858	0.390173	0	46.16958
imf5_HOS10	0.798988	4.096695	0.032347	0.529017	0	46.16943
imf5_HOS11	0.32559	1.669446	0.013182	0.21558	0	46.16866
imf5_HOS9	0.32559	1.669446	0.013182	0.21558	0	46.16866
imf5_HOS1	0.115901	0.594281	0.004692	0.076741	0	46.16808
imf5_HOS6	0.115901	0.594281	0.004692	0.076741	0	46.16808

imf5_HOS7	0.115901	0.594281	0.004692	0.076741	0	46.16808
imf5_HOS93	1.03E-15	5.02E-15	4.7E-17	9.02E-16	0	45.86475
imf2_HOS127	-53.4277	250.0596	-0.31263	63.2391	0	45.6164
imf2_HOS126	-64.9451	306.491	-0.28476	76.08815	0	45.57958
imf2_HOS115	59.52622	315.648	-0.31711	50.28519	0	45.45575
imf3_HOS70	35.78295	201.1488	-0.02002	20.72022	0	44.84274
imf2_HOS11	-102.997	471.0477	0.135042	137.2892	0	44.67791
imf5_HOS12	1.14E-15	5.66E-15	5.34E-17	1.12E-15	0	44.25844
imf5_Wavelet Entropy	-1944358	9682485	-142313	1624808	0	44.23152
imf1_Approximate Entropy	1.867612	0.219038	1.747978	0.245919	0	43.92212
imf2_HOS17	-73.4792	357.8484	0.112739	92.35347	0	43.86825
imf3_HOS49	17.42797	100.8947	0.033192	9.530932	0	43.6959
imf3_HOS111	32.80391	187.738	-0.12573	23.08014	0	43.50475
imf2_HOS34	40.04254	178.7304	0.490216	57.09218	0	43.47205
imf1_RR	0.098893	0.033481	0.117851	0.039955	0	43.07412
imf3_HOS29	23.08018	130.5759	0.08849	18.66541	0	42.89965
imf3_HOS59	25.87885	153.8151	0.009639	15.52498	0	42.43502
imf3_HOS30	18.88813	107.73	0.06049	16.68016	0	42.09146
imf3_HOS114	-24.2517	138.4646	-0.06666	22.28892	0	41.80678
imf2_HOS19	-63.2845	361.9058	0.590141	63.886	0	41.55597
imf2_HOS125	-69.9928	369.3955	-0.23828	90.67616	0	40.94344
imf1_DET	0.500666	0.138936	0.563119	0.136515	0	40.72157
imf3_HOS62	-15.5128	91.90937	0.057129	14.6372	0	40.61861
imf1_LAM	0.647081	0.128025	0.701469	0.119276	0	40.31894
imf3_HOS42	-7.25278	45.17167	0.079963	6.01237	0	39.9093
imf3_HOS83	30.41716	191.0977	-0.06182	22.17344	0	39.78418
imf2_Sample Entropy	0.90097	0.070043	0.852145	0.113713	0	39.75664
imf2_MMSE8	1.238769	0.246172	1.103981	0.309233	0	39.73217
imf2_HOS15	-82.118	479.2844	0.971177	96.5581	0	39.68223
imf3_HOS127	23.71053	149.4645	-0.14635	20.10862	0	39.19124
imf2_RR	0.061364	0.008806	0.069147	0.018591	0	39.14391
imf1_Vmax	40.23644	17.80215	51.06071	25.50476	0	39.03404
imf2_HOS131	53.09543	324.8004	-0.31119	54.91689	0	39.02557
imf1_MMSE2	0.42465	0.157001	0.362371	0.140599	0	38.9564
imf5_HOS107	8.91E-16	5.25E-15	4.05E-17	9.12E-16	0	38.2467
imf3_HOS86	-21.3784	134.5652	-0.00584	21.99055	0	37.91984
imf2_MMSE7	1.20327	0.24409	1.07593	0.308498	2.5004E-307	37.64368
imf4_HOS39	3.649764	20.10829	-0.07136	6.021117	9.6089E-303	37.35727
imf3_T1	17.49703	0.974014	16.63164	2.183385	5.7038E-299	37.11995
imf1_MMSE1	0.379149	0.12446	0.331156	0.114512	5.1399E-297	36.99643
imf2_HOS110	-57.0583	329.045	-0.42015	83.18102	1.3123E-296	36.97065
imf2_HOS111	-46.0969	266.234	-0.42653	70.30777	3.3542E-286	36.30575
imf4_HOS38	4.911818	26.77118	-0.09344	8.867027	1.2957E-283	36.13865
imf2_TT	3.265692	0.544414	3.672364	1.055816	3.0825E-280	35.91943
imf4_HOS40	2.260282	14.15027	-0.04535	3.310776	3.7458E-279	35.84873
imf5_HOS8	1.12E-15	6.97E-15	5.05E-17	1.31E-15	2.2367E-278	35.79807
imf2_MMSE6	1.139041	0.233736	1.023537	0.297709	2.3049E-272	35.40311

imf3_HOS31	13.41251	89.96502	0.040856	14.96835	5.8032E-272	35.37662
imf2_HOS128	-34.8833	211.6303	-0.32449	52.92526	2.9645E-269	35.1972
imf2_Trans	0.752882	0.014077	0.761183	0.021842	5.8063E-268	35.1113
imf2_HOS72	28.75847	187.61	-0.29451	39.87461	4.8547E-266	34.98312
imf2_HOS124	-69.8911	432.7131	-0.17301	106.102	1.7353E-265	34.94614
imf2_DET	0.450168	0.065804	0.489365	0.103924	1.8993E-264	34.87658
imf2_HOS24	-38.9303	247.8575	0.113987	57.03024	1.0382E-263	34.82712
imf1_Trans	0.797484	0.035858	0.81183	0.037266	1.2265E-258	34.48517
imf4_HOS37	6.02508	33.62967	-0.11166	11.73424	1.0577E-257	34.42174
imf2_Vmax	24.68333	10.97704	32.54233	21.35243	2.6072E-256	34.32717
imf5_HOS122	8.19E-16	5.32E-15	3.65E-17	9.94E-16	4.625E-255	34.24209
imf1_HOS16	-30.3546	150.9768	0.062556	64.36455	5.8984E-254	34.1666
imf2_HOS85	31.08474	209.4179	-0.32715	43.80083	7.4441E-252	34.0227
imf2_HOS109	-62.341	396.7266	-0.39109	96.8918	3.1078E-250	33.9113
imf2_HOS16	-62.6542	346.9179	-0.15413	122.0338	2.3471E-249	33.8508
imf4_HOS46	4.659321	29.49864	-0.06648	8.197816	2.6284E-241	33.2912
imf4_HOS47	3.964507	25.89394	-0.05597	6.581673	2.8019E-241	33.28925
imf2_MMSE5	1.035789	0.214454	0.936289	0.273292	2.4216E-240	33.22353
imf3_HOS71	20.73081	155.4424	-0.02631	18.5442	2.638E-240	33.22092
imf1_HOS73	21.67613	143.5082	0.333421	32.03634	1.8604E-239	33.16129
imf3_HOS97	22.89911	170.9439	-0.09831	22.26823	2.0602E-239	33.15817
imf5_HOS4	1.23E-15	8.23E-15	5.44E-17	1.56E-15	1.1216E-238	33.10635
imf5_HOS5	1.23E-15	8.24E-15	5.42E-17	1.56E-15	3.2284E-238	33.07398
imf5_HOS2	1.22E-15	8.19E-15	5.38E-17	1.54E-15	8.2702E-238	33.04515
imf1_HOS17	-24.43	129.8299	-0.14255	51.59076	2.8273E-237	33.00744
imf3_HOS36	-15.4741	114.9035	0.172515	17.04716	3.0225E-237	33.00539
imf5_HOS3	1.28E-15	8.7E-15	5.65E-17	1.63E-15	1.954E-234	32.80616
imf4_HOS31	3.640128	22.95926	-0.09609	7.065505	6.658E-230	32.48238
imf2_MMSE1	0.535241	0.068322	0.499528	0.101669	1.8115E-228	32.37923
imf3_Lmax	130.8133	81.77042	190.5556	174.2711	4.373E-224	32.06214
imf4_HOS30	5.350921	32.92561	-0.12725	11.06244	1.5344E-222	31.94962
imf4_HOS48	3.141162	22.45443	-0.04239	5.057996	6.9389E-217	31.53447
imf4_HOS45	-5.58532	33.80623	0.127399	12.06442	8.377E-217	31.52842
imf1_HOS101	26.17732	175.2515	0.231892	47.40496	1.243E-210	31.06914
imf3_HOS129	-15.0175	114.9325	-0.10803	19.00494	1.6707E-208	30.9092
imf2_MMSE4	0.895299	0.18322	0.816611	0.23284	1.7318E-207	30.8326
imf1_HOS115	24.42773	167.5669	0.167197	43.73417	1.3031E-206	30.76634
imf4_HOS29	6.894618	43.27698	-0.15373	15.11491	7.7433E-206	30.70772
imf4_HOS36	-6.38572	39.44344	0.117667	14.1814	4.5468E-205	30.64938
imf1_HOS62	17.60948	109.414	0.295748	36.89124	5.6353E-201	30.33693
imf2_HOS23	-40.2393	264.1132	-0.14379	82.33837	2.2233E-198	30.13712
imf2_HOS99	29.85195	231.0184	-0.35327	46.50205	9.2534E-196	29.93421
imf1_<L>	4.127769	0.973868	4.529376	1.224518	2.682E-195	29.89827
imf2_HOS108	-63.5649	462.7569	-0.33813	110.2939	2.9444E-195	29.89512
imf1_ENTR	1.767895	0.270261	1.85956	0.274183	6.2692E-195	29.86956
imf4_HOS55	-4.34128	29.65125	0.123219	9.357652	3.4479E-193	29.73371
imf3_Trans	0.745391	0.002871	0.748019	0.008322	3.9157E-193	29.72939

imf4_HOS44	-3.99941	25.75127	0.089725	9.175464	4.0454E-192	29.64993
imf3_Vmax	23.71911	10.14292	31.85866	25.92263	3.9763E-190	29.49322
imf1_HOS116	19.41772	117.9916	0.197301	45.03728	1.4897E-188	29.36887
imf1_HOS22	-35.2594	242.3301	0.341862	74.7796	1.4386E-187	29.29079
imf1_HOS100	29.20141	227.6589	0.227475	45.15665	6.6642E-187	29.23788
imf1_TT	4.503207	1.401651	5.068214	1.763881	1.847E-186	29.20265
imf2_HOS123	-66.4341	492.3498	-0.0898	121.29	3.1684E-186	29.18399
imf2_MMSE2	0.617459	0.088732	0.578403	0.12299	9.1652E-186	29.14721
imf2_HOS95	-48.3639	357.5878	-0.54228	87.90083	1.0165E-183	28.98364
imf1_HOS23	-30.6906	227.8115	0.182933	58.49008	2.0623E-183	28.95898
imf1_HOS86	28.4754	228.5723	0.286271	41.39624	1.4052E-182	28.89201
imf2_HOS20	-43.9246	350.1651	0.762425	74.2359	4.9651E-182	28.84787
imf4_HOS35	-4.29573	28.28451	0.069474	10.1445	1.7174E-180	28.7236
imf2_MMSE3	0.739132	0.136669	0.683713	0.176896	3.1883E-179	28.62076
imf2_ENTR	1.45553	0.110347	1.511208	0.180321	6.0364E-179	28.59824
imf1_HOS72	15.42206	102.9468	0.366492	33.34678	2.1918E-178	28.5527
imf1_HOS87	28.9317	226.8366	0.267398	48.52534	1.0038E-177	28.49886
imf3_TT	3.052893	0.290041	3.423325	1.229971	2.4088E-177	28.46785
imf2_HOS28	41.52187	257.9114	0.750045	99.20451	2.4289E-176	28.38581
imf2_HOS60	22.1553	177.9981	-0.27626	38.38943	4.8737E-176	28.36104
imf1_HOS74	26.07618	203.9002	0.293138	44.66447	8.6755E-176	28.34052
imf4_HOS28	-6.77328	46.48423	0.094632	15.65842	9.4334E-176	28.33753
imf2_HOS25	-28.5293	237.0972	0.350687	44.42875	9.6753E-176	28.33663
imf3_HOS51	-5.86976	50.66623	0.059657	7.644034	2.9962E-175	28.29635
imf4_HOS32	1.788084	14.4388	-0.06036	3.4058	7.5885E-173	28.09831
imf2_HOS96	-38.158	288.5357	-0.51852	74.71679	3.3709E-169	27.79514
imf5_HOS91	1.199455	10.76248	0.00768	1.229297	1.3314E-167	27.66142
imf2_HOS94	-53.9561	427.3382	-0.5402	100.6225	4.3734E-165	27.44936
imf1_HOS24	-22.4147	181.6424	0.005296	41.24663	2.1191E-164	27.39133
imf3_HOS60	12.32865	112.0843	0.009246	13.53075	1.8305E-163	27.31184
imf1_HOS85	24.90377	208.9097	0.301124	40.30614	1.9355E-162	27.22464
imf4_HOS54	-3.27701	24.92958	0.096438	7.653885	3.0227E-160	27.03696
imf2_HOS112	-28.4423	220.0025	-0.41357	59.13592	1.8445E-157	26.79678
imf3_RR	0.057392	0.004238	0.062047	0.016486	4.5541E-156	26.67592
imf1_HOS131	15.96879	108.1533	0.112636	40.66196	1.116E-155	26.64204
imf5_HOS90	1.057893	9.86769	0.007298	1.117973	2.2696E-155	26.61518
imf1_HOS114	26.68956	224.8173	0.144524	48.2654	3.0296E-155	26.60424
imf4_HOS49	2.205702	19.43365	-0.02554	3.772576	4.0705E-154	26.50566
imf3_HOS35	-11.1107	103.1464	0.124677	15.13879	2.1475E-153	26.44236
imf1_HOS130	19.55068	149.2467	0.069827	44.50084	7.4066E-153	26.39514
imf2_Permutation Entropy	1.012339	0.051147	1.027643	0.051824	1.0903E-152	26.38038
imf2_HOS107	-62.6518	522.8875	-0.26103	122.1899	2.4354E-151	26.26148
imf5_HOS105	1.728846	16.05852	0.012025	2.236456	6.1921E-150	26.13706
imf1_HOS102	20.55782	134.4068	0.239856	55.4275	7.6899E-150	26.12871
imf5_HOS104	1.516363	14.12573	0.010876	1.938879	1.4605E-149	26.10397
imf1_HOS99	28.83237	256.5074	0.224253	47.3173	9.6839E-149	26.03087
imf1_HOS88	26.26069	204.7428	0.248707	59.14759	1.4457E-148	26.01536

imf5_HOS103	1.301272	12.26116	0.009757	1.645638	6.0123E-147	25.87064
imf4_HOS22	7.223952	56.36002	-0.19173	18.14894	1.1371E-145	25.75595
imf5_MMSE8	0.592039	0.115788	0.627955	0.127111	2.3598E-142	25.4556
imf3_HOS99	-14.1068	131.4996	-0.05981	21.9871	8.8639E-142	25.4032
imf2_HOS93	-56.7752	491.8444	-0.50919	111.5272	1.029E-141	25.39729
imf4_HOS43	-2.39144	18.31753	0.052713	6.305205	5.1065E-141	25.33371
imf5_HOS102	1.085212	10.51489	0.008674	1.363218	4.4075E-140	25.24792
imf2_<L>	3.294557	0.270866	3.46354	0.627898	7.7765E-140	25.22527
imf4_HOS136	11.3679	93.29349	-0.14536	27.23229	3.2574E-139	25.16804
imf5_HOS89	0.915512	9.064545	0.006931	1.016352	2.9404E-138	25.0799
imf5_MMSE7	0.57	0.110029	0.602412	0.116101	6.2723E-138	25.04947
imf4_HOS23	5.240692	43.43291	-0.15631	13.06765	8.777E-138	25.03597
imf2_HOS114	26.05393	245.0849	-0.35204	46.88686	6.7998E-137	24.95353
imf5_HOS117	1.421457	13.73292	0.010996	2.050005	5.1193E-136	24.87198
imf5_HOS116	1.137912	11.0709	0.009257	1.59521	2.274E-135	24.81158
imf5_HOS118	1.704412	16.5156	0.012793	2.512885	1.528E-134	24.7342
imf4_HOS21	-6.80001	56.41139	0.059498	16.76496	2.3962E-133	24.62197
imf4_HOS27	-4.20762	34.14012	0.036544	10.72726	4.5221E-133	24.596
imf5_HOS119	1.984751	19.36163	0.014639	2.977354	2.1347E-132	24.53244
imf5_MMSE6	0.546325	0.107688	0.576243	0.108938	2.3603E-132	24.52832
imf1_HOS29	-35.4455	303.5297	0.503265	85.94437	2.0442E-131	24.43961
imf2_HOS122	-61.5824	544.93	0.009845	135.3062	3.4526E-131	24.41803
imf2_Lmax	63.65578	27.67295	84.26187	79.7023	2.5641E-130	24.33528
imf5_HOS120	2.260382	22.24189	0.016524	3.4402	5.8436E-130	24.30121
imf5_HOS131	1.086204	10.67253	0.008813	1.662319	7.5363E-130	24.29068
imf5_HOS130	0.745175	7.429946	0.006578	1.07274	9.2134E-129	24.18679
imf4_HOS135	9.60663	82.18923	-0.1154	23.85784	1.1808E-128	24.17647
imf5_HOS115	0.855714	8.652547	0.007583	1.164186	1.6166E-127	24.06736
imf5_MMSE5	0.518576	0.108638	0.547093	0.105699	1.1004E-126	23.98708
imf5_HOS132	1.429812	14.17241	0.01114	2.273625	1.5462E-126	23.97282
imf2_HOS92	-58.768	547.8903	-0.44745	119.4994	1.2592E-125	23.88468
imf5_HOS101	0.869741	8.971076	0.007633	1.104079	4.3351E-125	23.83257
imf3_HOS112	13.97428	143.7932	-0.12408	20.94013	4.9354E-125	23.8271
imf1_HOS18	-16.1188	121.4623	-0.34636	44.96277	1.2826E-124	23.78676
imf4_MMSE8	0.77018	0.206849	0.82899	0.222439	1.9282E-124	23.76952
imf1_HOS75	27.73389	251.1603	0.251269	61.36366	2.4002E-124	23.76026
imf5_MMSE4	0.482463	0.112097	0.510869	0.105943	2.9075E-124	23.75214
imf5_MMSE3	0.43055	0.116209	0.459645	0.108729	1.8141E-123	23.67451
imf5_HOS133	1.773711	17.77729	0.013547	2.889604	2.5239E-123	23.66048
imf2_HOS106	-61.518	574.3103	-0.16061	131.7285	3.9446E-123	23.6415
imf3_HOS73	-10.9997	111.3758	0.008285	18.28179	1.6911E-122	23.57952
imf3_HOS22	15.0572	150.1988	0.067986	26.50358	1.1193E-121	23.4988
imf4_HOS34	-2.21397	18.20795	0.023142	6.183447	1.9024E-121	23.4761
imf5_HOS134	2.115525	21.43316	0.016023	3.504574	1.6011E-120	23.38471
imf1_HOS129	20.62339	186.4693	0.040548	50.08769	6.8615E-119	23.22262
imf4_HOS134	7.911986	70.68145	-0.08818	20.39182	1.4891E-118	23.18906
imf5_HOS135	2.452799	25.11685	0.018556	4.11593	6.0747E-118	23.12805

imf4_MMSE7	0.720336	0.176114	0.768887	0.189029	1.5523E-117	23.08724
imf3_HOS50	5.869341	63.26161	0.03818	7.31879	1.1884E-116	22.99847
imf1_HOS11	-22.9004	173.9544	-0.31229	68.76153	1.9386E-116	22.97708
imf5_HOS88	0.77346	8.393564	0.006583	0.930003	1.6169E-115	22.88413
imf5_HOS136	2.783043	28.81731	0.021136	4.722235	2.1489E-115	22.87163
imf1_HOS113	25.57798	253.0533	0.126808	53.10659	1.2607E-114	22.79377
imf1_HOS61	10.10632	83.36108	0.358157	27.16384	2.1457E-114	22.77032
imf1_HOS30	-33.0418	329.6063	0.403542	73.39398	3.9585E-113	22.64133
imf1_HOS63	23.53398	217.1114	0.231801	58.4903	2.6646E-112	22.55657
imf1_HOS98	25.07886	254.3684	0.217853	50.64234	4.1522E-111	22.43394
imf4_HOS120	8.060341	75.85614	-0.08094	20.83539	9.0615E-111	22.39897
imf5_HOS78	0.682131	7.562572	0.003509	0.900429	4.3653E-110	22.32835
imf4_MMSE6	0.673628	0.143393	0.711696	0.153391	8.1374E-110	22.30032
imf1_HOS84	19.01917	181.2738	0.306779	45.12735	1.2165E-109	22.2822
imf4_HOS133	6.283568	58.85473	-0.06324	16.85205	1.8989E-108	22.158
imf2_HOS33	15.39973	148.0139	0.33287	35.97128	2.8074E-108	22.14027
imf2_HOS81	-39.796	388.9409	-0.6633	91.1796	4.0588E-108	22.12354
imf3_HOS84	13.34326	148.9699	-0.06094	20.57311	3.8237E-107	22.0215
imf4_HOS53	-2.16623	20.84912	0.069279	6.009627	1.0576E-106	21.97506
imf2_HOS80	-45.6498	455.428	-0.69484	102.4018	1.2865E-106	21.9661
imf4_HOS121	-10.8209	104.7688	0.240463	29.92183	3.0211E-104	21.71515
imf2_HOS79	-50.0878	512.8364	-0.69197	110.3251	5.1048E-104	21.69088
imf4_HOS122	-9.48651	92.50953	0.213654	26.26641	2.6416E-103	21.61467
imf1_HOS37	-31.4163	299.3675	0.545515	90.10982	2.6651E-102	21.50705
imf4_HOS123	-8.11518	79.98382	0.185552	22.54634	8.7257E-102	21.45163
imf5_MMSE2	0.348004	0.11558	0.374933	0.111721	1.9984E-101	21.41282
imf4_HOS124	-6.7238	67.2647	0.156981	18.78195	1.2048E-99	21.21981
imf4_HOS119	6.672889	66.4819	-0.05807	18.0983	1.8865E-99	21.1986
imf4_HOS24	3.07379	32.11157	-0.11541	8.34937	7.6603E-99	21.13215
imf4_MMSE5	0.630848	0.113031	0.659128	0.120299	1.15781E-98	21.11253
imf5_HOS114	0.576701	6.757035	0.005984	0.803803	8.34632E-98	21.01843
imf2_HOS121	-57.1502	587.9156	0.124011	147.6842	2.42871E-97	20.96738
imf4_HOS66	-2.64448	29.00332	0.105208	6.672091	2.74416E-97	20.96154
imf4_HOS132	4.71702	46.87919	-0.03995	13.2695	4.13825E-97	20.94186
imf1_HOS89	21.15475	176.3162	0.233425	70.10993	5.44279E-97	20.92873
imf5_HOS100	0.656319	7.766591	0.006638	0.893124	1.40795E-96	20.88312
imf2_T2	27.44072	1.917138	27.95612	2.237706	1.88862E-96	20.869
imf4_HOS125	-5.32421	54.48377	0.12869	15.00269	1.91591E-96	20.86831
imf3_HOS32	7.150027	81.42548	0.036464	13.76878	3.08376E-95	20.7343
imf5_HOS77	0.618321	7.416492	0.003907	0.870579	2.0641E-94	20.64211
imf3_HOS23	12.87117	146.9437	0.03179	25.66021	3.5884E-94	20.61522
imf5_HOS33	-0.24883	2.817042	-0.00229	0.497698	4.63112E-94	20.6028
imf4_HOS56	2.845291	33.00872	-0.01885	5.650401	1.42721E-93	20.54793
imf2_HOS82	-30.5649	317.4673	-0.60238	77.87409	7.28257E-93	20.46822
imf1_HOS25	-12.1836	119.7706	-0.16899	34.94992	8.51683E-93	20.46055
imf3_Approximate Entropy	1.627104	0.24008	1.681573	0.238117	4.03563E-92	20.38414
imf4_HOS16	6.970313	72.34957	-0.22436	20.92368	7.40119E-92	20.35428

imf2_HOS22	-32.9531	284.8629	-0.40575	111.5777	1.54845E-91	20.31788
imf1_HOS31	-26.1858	306.487	0.271067	55.07853	5.61077E-91	20.25423
imf5_HOS129	0.408902	4.977524	0.004446	0.58898	8.96197E-91	20.23103
imf4_HOS126	-3.92296	41.89106	0.101277	11.25979	1.49302E-90	20.20571
imf1_HOS76	26.35069	269.2779	0.212776	75.93253	2.71438E-89	20.06126
imf1_HOS128	18.86822	197.0435	0.022664	53.41881	3.0573E-89	20.05531
imf4_HOS57	2.553194	30.39643	-0.0156	5.155265	3.65114E-89	20.04644
imf4_HOS118	5.363192	56.81569	-0.03798	15.30475	1.37713E-88	19.97992
imf5_HOS87	0.632794	7.901864	0.006255	0.865786	1.03301E-87	19.87855
imf4_MMSE4	0.589965	0.092027	0.611343	0.097014	8.69251E-87	19.77084
imf4_HOS15	-6.53788	71.40443	0.0139	18.1194	4.87547E-86	19.68321
imf1_HOS52	14.64879	130.692	0.181113	51.63147	2.77462E-85	19.59446
imf4_MMSE3	0.545369	0.08474	0.564672	0.088552	8.0368E-85	19.53998
imf2_HOS97	-21.9224	231.365	-0.47408	62.39425	2.79935E-84	19.47586
imf1_HOS38	-30.6332	356.1989	0.506594	82.5969	1.12976E-82	19.28464
imf2_HOS130	20.39227	251.6248	-0.31782	46.90439	1.05178E-81	19.16836
imf5_HOS26	-0.72497	9.084939	-0.00815	1.346592	2.32881E-81	19.12677
imf4_HOS131	3.204542	35.12028	-0.01763	9.708857	3.70005E-81	19.1025
imf1_HOS112	21.2756	246.4208	0.111283	55.58818	4.24454E-81	19.0953
imf4_LAM	0.932568	0.07078	0.916453	0.07666	1.33686E-79	18.91342
imf4_HOS106	-7.71432	88.06571	0.18735	23.53428	1.4004E-79	18.91096
imf1_HOS46	-25.5836	270.1319	0.492658	88.33649	2.10703E-78	18.7668
imf5_HOS76	0.555093	7.337974	0.004303	0.847031	4.04325E-78	18.73198
imf4_HOS117	4.127096	47.028	-0.02009	12.48584	2.7512E-77	18.62916
imf1_HOS64	26.69219	304.9296	0.173743	78.53394	9.24436E-77	18.56388
imf4_HOS65	-2.10791	26.22086	0.08939	6.014457	1.3472E-76	18.54355
imf4_HOS107	-6.63807	77.56262	0.165618	20.5578	1.39906E-76	18.54151
imf4_HOS127	-2.52146	30.05915	0.07513	7.674465	3.41845E-76	18.49319
imf4_HOS58	2.15523	27.79814	-0.01005	4.731507	5.75666E-76	18.46495
imf3_Permutation Entropy	0.905917	0.038681	0.9143	0.040734	5.869E-76	18.4639
imf5_HOS20	-1.35321	17.78525	-0.01568	2.524913	5.77534E-75	18.33947
imf4_HOS108	-5.55665	66.89793	0.143269	17.54423	6.95033E-73	18.07604
imf4_HOS105	4.91466	59.36178	-0.0211	14.75575	5.98337E-72	17.95641
imf5_HOS21	-1.82727	24.2773	-0.02022	3.806255	1.90245E-71	17.89181
imf5_HOS15	-2.1358	28.86942	-0.02492	4.027304	2.7201E-71	17.8718
imf5_HOS27	-1.10825	14.62841	-0.01198	2.438584	5.63063E-71	17.831
imf1_Lmax	64.77256	21.9047	78.48961	72.84187	1.99733E-70	17.75978
imf1_HOS97	18.80392	230.5014	0.206293	53.94138	2.35877E-70	17.75041
imf4_HOS20	-3.79715	45.86127	-0.0077	11.6273	3.36304E-70	17.73039
imf4_HOS41	0.769952	10.65773	-0.01563	1.742694	3.57074E-69	17.59653
imf4_HOS109	-4.48149	56.18356	0.121066	14.52096	3.50814E-68	17.4661
imf2_HOS67	-37.666	472.526	-0.85625	103.7843	4.91053E-68	17.44683
imf2_K-S Entropy	0.093775	0.115481	0.118163	0.125859	5.11626E-68	17.44447
imf5_T1	16.08229	2.349158	16.50746	2.161617	2.11774E-67	17.3628
imf4_MMSE2	0.487039	0.084242	0.504529	0.090882	5.50196E-67	17.30769
imf4_HOS17	4.540681	57.96827	-0.17919	15.1189	5.62598E-67	17.3064
imf1_HOS12	-17.3386	180.4949	-0.54362	64.9485	7.48786E-67	17.28987

imf4_Approximate Entropy	1.168711	0.216721	1.21967	0.268588	9.44684E-67	17.27642
imf1_HOS32	-16.3816	228.3175	0.123082	37.35398	1.35561E-66	17.25549
imf1_HOS132	10.58514	105.9579	0.167171	43.25977	2.30121E-65	17.09052
imf1_HOS53	21.69332	261.9444	0.10411	75.24028	4.59326E-64	16.91439
imf1_HOS47	-24.9856	320.6436	0.504111	84.06463	1.02425E-63	16.8669
imf4_HOS116	2.956375	37.45776	-0.00374	9.703353	1.72695E-63	16.8359
imf5_HOS28	-1.49173	20.75669	-0.01598	3.57778	2.4432E-63	16.81527
imf5_HOS10	-2.42558	35.36833	-0.03028	4.387511	4.28816E-63	16.78178
imf3_Sample Entropy	0.837588	0.058621	0.820635	0.093475	4.57582E-63	16.77791
imf5_HOS14	-1.57482	23.03442	-0.01993	2.777398	4.75643E-63	16.77561
imf1_HOS77	22.7694	262.3247	0.178226	86.02339	1.1772E-62	16.72149
imf5_HOS75	0.493075	7.333668	0.004695	0.83106	4.0768E-62	16.64704
imf2_HOS68	-31.9421	415.4912	-0.79038	94.35421	4.72041E-62	16.63823
imf4_HOS110	-3.41876	45.62686	0.099652	11.53347	1.64591E-61	16.563
imf5_Sample Entropy	0.627309	0.072968	0.640631	0.071828	3.74035E-61	16.51337
imf4_HOS104	3.955252	52.05868	-0.00659	12.78055	4.64528E-61	16.50024
imf5_HOS19	-0.88134	13.22724	-0.01135	1.518627	1.67494E-60	16.42235
imf1_HOS39	-25.3313	365.558	0.431211	67.96564	1.687E-60	16.42191
imf1_HOS117	12.68546	133.3523	0.233075	53.3507	1.88583E-60	16.41513
imf5_HOS34	-0.54063	7.629023	-0.0054	1.410324	4.12676E-60	16.36736
imf1_HOS127	14.59302	183.167	0.013336	54.08096	1.20894E-58	16.15976
imf1_HOS56	-20.5647	248.8407	0.375824	83.80446	1.61358E-58	16.14189
imf4_HOS50	1.180188	17.29529	-0.00548	3.079379	2.51393E-58	16.11442
imf5_HOS86	0.494465	7.636066	0.005951	0.830822	7.29003E-58	16.04824
imf2_HOS31	-14.9581	194.0623	-0.1151	52.97938	1.62782E-57	15.99814
imf1_HOS65	26.96267	357.4461	0.123113	92.83528	2.07871E-57	15.98286
imf1_Permutation Entropy	1.248151	0.093435	1.265226	0.09556	2.21569E-57	15.97886
imf5_HOS122	-1.65526	24.57185	-0.00675	4.205707	9.47012E-57	15.88776
imf5_HOS123	-1.40247	20.87395	-0.00561	3.575304	1.85819E-56	15.8453
imf5_HOS121	-1.89075	28.30292	-0.00772	4.834127	6.97409E-56	15.76168
imf1_K-S Entropy	0.166076	0.162191	0.195651	0.169266	3.48338E-55	15.65939
imf5_ENTR	2.137839	0.415513	2.068599	0.392715	6.58785E-55	15.61868
imf5_HOS99	0.446301	7.090829	0.005696	0.774889	1.17422E-54	15.58166
imf3_HOS24	9.69996	147.8594	0.010068	25.05607	1.99321E-54	15.5477
imf5_HOS124	-1.1334	17.21667	-0.00431	2.944398	2.50562E-54	15.53299
imf4_HOS59	1.662216	25.35847	-0.00187	4.4175	4.89781E-54	15.48982
imf5_HOS35	-0.83283	12.58323	-0.00864	2.331263	1.36619E-52	15.27368
imf1_T2	22.65504	4.382694	21.81334	4.997538	2.7334E-52	15.22827
imf1_HOS54	25.90958	368.2218	0.041056	94.00959	4.736E-51	15.04006
imf4_HOS130	1.735837	24.54348	0.004454	6.355963	5.4711E-51	15.03048
imf3_HOS34	-5.6127	91.77992	0.081465	13.82395	8.07117E-51	15.00463
imf4_HOS103	3.079521	44.62973	0.00528	10.7966	8.20972E-51	15.0035
imf5_HOS6	-2.7081	44.53404	-0.03653	5.06284	9.80616E-51	14.99167
imf4_HOS111	-2.36929	35.6376	0.079483	8.672704	2.16241E-50	14.9389
imf5_<L>	5.887131	2.689567	5.488017	2.343079	2.81334E-50	14.92131
imf1_HOS103	13.53463	145.8983	0.251022	66.00795	3.65093E-50	14.90386
imf2_HOS69	-24.1326	348.2679	-0.69108	81.53055	1.556E-49	14.80643

imf4_HOS11	6.090512	91.57357	-0.24993	23.68343	3.13911E-49	14.75903
imf5_HOS36	-1.1239	17.59849	-0.01201	3.251819	4.08324E-49	14.74124
imf4_HOS92	-4.71449	71.68228	0.134318	17.31804	4.19687E-49	14.73938
imf5_HOS125	-0.84925	13.62209	-0.00284	2.315566	4.62338E-49	14.73282
imf2_HOS30	-18.7199	243.0256	-0.36809	78.85009	4.65009E-49	14.73243
imf4_HOS64	-1.5063	23.83332	0.07235	5.408252	7.26916E-49	14.70213
imf5_HOS106	-1.35646	22.12737	-0.00317	3.560951	1.83344E-48	14.63918
imf2_HOS40	9.744106	148.1459	-0.08799	34.49644	2.34791E-48	14.62231
imf4_Permutation Entropy	0.825632	0.029918	0.831041	0.033377	2.37636E-48	14.62149
imf1_HOS57	-18.987	268.5736	0.423837	81.00408	7.04515E-48	14.54711
imf4_T1	17.29615	1.403663	16.98145	1.995379	1.42492E-47	14.49871
imf5_HOS74	0.432798	7.407264	0.005083	0.823824	2.56902E-47	14.45808
imf4_HOS10	-6.07559	93.44099	-0.04024	20.65213	3.27085E-47	14.4414
imf5_HOS25	-0.34397	5.905742	-0.0045	0.645477	4.87725E-47	14.41377
imf5_HOS107	-1.15568	19.16351	-0.00244	3.078927	5.26526E-47	14.40847
imf1_HOS90	15.07794	162.2985	0.219608	78.80542	1.4649E-46	14.33742
imf1_HOS111	14.71505	217.0604	0.097346	56.40236	1.57715E-46	14.33229
imf5_HOS9	-1.7833	31.10051	-0.02496	3.416135	1.57088E-45	14.17136
imf1_HOS66	25.55395	381.8186	0.075801	100.4828	2.46565E-45	14.13959
imf5_HOS39	0.476635	7.858779	0.006414	1.40609	8.60056E-45	14.05117
imf5_MMSE1	0.195172	0.084044	0.208889	0.087681	1.33791E-44	14.01976
imf4_HOS93	-3.93504	63.27344	0.118175	15.12943	1.70486E-44	14.00251
imf4_HOS26	-1.68615	25.62319	-0.01838	6.47957	2.39015E-44	13.97842
imf5_TT	7.312239	3.736817	6.758539	3.517998	4.35257E-44	13.93558
imf1_HOS78	18.74536	245.131	0.142565	90.88174	8.16846E-44	13.89045
imf5_HOS48	0.491592	8.394433	0.007881	1.30148	1.01049E-43	13.87517
imf5_HOS108	-0.94116	16.25766	-0.00158	2.59812	1.44693E-43	13.84934
imf1_HOS67	-17.0876	243.5733	0.229675	79.4539	1.70776E-43	13.8374
imf5_HOS40	0.279589	4.792747	0.004264	0.748089	2.22911E-43	13.81818
imf1_HOS48	-20.3242	339.4127	0.484543	73.11385	2.79894E-43	13.80175
imf5_HOS38	0.669819	11.16622	0.008423	2.0874	3.45881E-43	13.78644
imf5_HOS47	0.600737	10.18487	0.009304	1.732714	4.52526E-43	13.76699
imf4_HOS115	1.839448	28.83482	0.011834	7.103374	7.82818E-43	13.72723
imf1_HOS83	11.30753	153.9874	0.297788	52.60366	3.24541E-42	13.62354
imf1_HOS55	27.73383	447.0678	-0.01262	105.8375	4.05712E-42	13.60719
imf2_HOS49	11.23629	187.3104	-0.2852	43.3147	5.92172E-42	13.57946
imf5_HOS37	0.85784	14.54987	0.010278	2.775179	1.73568E-41	13.50027
imf5_HOS46	0.707224	12.10429	0.010618	2.179961	1.8037E-41	13.49743
imf5_HOS49	0.380609	6.839955	0.00636	0.908763	3.21365E-41	13.45471
imf2_HOS83	-16.2144	249.9432	-0.51946	64.04171	4.65453E-41	13.42723
imf1_HOS44	20.43021	317.8887	-0.07557	88.8633	9.33956E-41	13.37543
imf4_HOS42	-0.79117	12.45704	0.0173	3.555058	1.27156E-40	13.35242
imf4_HOS102	2.279149	37.36892	0.015147	8.858252	3.44064E-40	13.2779
imf1_HOS40	-16.8813	312.0247	0.32663	48.60643	3.8349E-40	13.26976
imf1_HOS43	13.5071	190.9713	0.000128	67.45308	4.20011E-40	13.26293
imf4_HOS94	-3.18065	54.81517	0.102126	12.93588	2.06588E-39	13.14268
imf5_HOS3	-2.99831	56.94114	-0.04395	6.191604	1.08887E-38	13.01605

imf4_HOS52	-1.03443	17.90961	0.042647	4.514819	3.38696E-38	12.92889
imf5_HOS126	-0.55135	10.14936	-0.00123	1.694307	5.34829E-38	12.89364
imf3_HOS41	1.861077	34.42927	0.053597	4.880168	1.67639E-37	12.80507
imf1_HOS45	24.82811	424.1809	-0.13237	103.8488	2.65343E-37	12.7693
imf5_HOS109	-0.71376	13.43792	-0.0006	2.121532	3.73163E-37	12.74267
imf5_HOS113	0.302604	5.921607	0.004468	0.652516	1.86472E-36	12.6163
imf4_RR	0.05843	0.00796	0.06045	0.014918	1.96156E-36	12.6123
imf4_HOS128	-1.11643	20.66137	0.050392	4.685417	5.05788E-36	12.53729
imf1_HOS68	-14.5938	228.8822	0.297829	76.54757	6.25804E-36	12.52037
imf3_T2	35.25179	4.92666	36.08412	6.070329	1.04326E-35	12.47966
imf5_HOS92	-0.83434	16.54286	0.001034	2.374614	1.02265E-34	12.29621
imf5_HOS13	-1.01876	20.50104	-0.0152	2.212045	1.13049E-34	12.28809
imf5_HOS73	0.374695	7.559075	0.005467	0.826199	1.84265E-34	12.24845
imf5_Vmax	81.61	59.39189	73.8062	56.72385	3.20348E-34	12.20343
imf5_Permutation Entropy	0.773562	0.021212	0.77671	0.02331	4.90581E-34	12.16862
imf2_HOS56	-24.5783	428.3999	-0.9226	99.89793	5.39619E-34	12.16083
imf1_HOS7	-16.3292	235.618	-0.74611	87.50411	1.20517E-33	12.09489
imf4_HOS95	-2.45732	46.46229	0.086844	10.77476	1.46567E-33	12.07878
imf2_HOS21	-18.558	334.353	0.86677	94.85307	4.85296E-33	11.97974
imf5_HOS29	0.880882	17.02236	0.008509	3.239712	1.55252E-32	11.88277
imf5_HOS85	0.359332	7.629689	0.005673	0.830316	3.16922E-31	11.62755
imf5_HOS5	-1.99221	42.38953	-0.03101	4.558727	3.58063E-31	11.6171
imf5_Trans	0.756085	0.012736	0.754424	0.012797	5.39775E-31	11.58191
imf5_HOS50	0.268567	5.731236	0.00475	0.629749	9.03023E-31	11.53765
imf3_LAM	0.736419	0.103079	0.750162	0.106981	1.30788E-30	11.50568
imf2_HOS27	14.59701	240.146	0.683506	74.88584	1.39166E-30	11.50031
imf5_HOS30	0.6076	12.14865	0.006091	2.310871	1.72835E-30	11.48157
imf5_HOS45	-0.72129	14.36903	-0.00818	2.787013	2.23464E-30	11.4593
imf5_HOS93	-0.67813	14.47998	0.001466	2.059219	2.70606E-30	11.44268
imf1_HOS71	7.851227	115.5216	0.383663	45.67021	2.86974E-30	11.43757
imf4_HOS112	-1.32889	27.11785	0.060781	6.16684	6.39726E-30	11.36768
imf1_HOS79	-14.5165	261.551	0.090593	77.75544	1.2778E-29	11.30702
imf1_HOS58	-13.8152	264.2266	0.447407	72.39184	1.8206E-29	11.27586
imf1_RTE	0.469	0.142191	0.451704	0.136529	2.60345E-29	11.24429
imf5_HOS1	-3.31476	73.00888	-0.05282	7.834079	3.40591E-29	11.22051
imf1_HOS96	10.6824	188.5881	0.185954	56.92524	4.33911E-29	11.19904
imf3_DET	0.591519	0.089212	0.605302	0.112588	6.51062E-29	11.16298
imf5_T2	104.4922	36.40003	100.3852	32.67709	2.11929E-28	11.05742
imf5_RR	0.064219	0.014896	0.062371	0.014919	2.41715E-28	11.0456
imf5_HOS44	-0.52273	10.81852	-0.0055	2.106541	2.88278E-28	11.02974
imf3_HOS10	18.2106	400.0544	-0.13542	63.93074	4.50157E-28	10.98952
imf1_HOS36	18.34158	358.3717	-0.29039	95.27109	5.11356E-28	10.978
imf5_HOS59	0.355145	7.917341	0.00709	0.922632	6.15457E-28	10.96121
imf5_HOS60	0.326697	7.373914	0.006119	0.80251	1.13626E-27	10.90551
imf4_HOS101	1.541866	30.81698	0.023752	7.073736	1.22394E-27	10.89873
imf3_K-S Entropy	0.110504	0.130245	0.126421	0.130449	1.41862E-27	10.88527
imf4_HOS60	1.091151	23.30254	0.009034	4.256359	1.86234E-27	10.86041

imf5_HOS58	0.384479	8.574473	0.008013	1.092227	2.11782E-27	10.84865
imf1_HOS80	-11.9125	212.4756	0.161182	73.1161	4.00498E-27	10.79016
imf2_HOS57	-19.0016	371.9855	-0.78956	87.57095	6.05258E-27	10.75209
imf1_HOS126	8.85441	156.9373	0.009475	53.58789	6.80373E-27	10.74128
imf3_MMSE2	0.57831	0.067375	0.587221	0.074935	7.98351E-27	10.72649
imf1_HOS51	5.651082	97.04548	0.267914	32.28332	1.05461E-26	10.70068
imf4_HOS14	-3.14476	65.1443	-0.06153	13.98448	1.55831E-26	10.6644
imf3_HOS15	13.77839	310.4418	-0.04831	50.09087	1.69976E-26	10.6563
imf5_HOS57	0.414379	9.316452	0.00888	1.292377	1.8935E-26	10.64624
imf5_HOS110	-0.47447	10.76458	0.000504	1.655121	2.06098E-26	10.63833
imf4_HOS96	-1.76556	38.49522	0.072845	8.711214	2.83864E-26	10.60842
imf5_HOS61	0.299397	6.978835	0.005104	0.755057	3.71487E-26	10.58321
imf5_HOS56	0.44446	10.12129	0.009687	1.511319	2.52034E-25	10.40209
imf3_HOS16	9.638546	219.4438	0.024502	37.56613	3.35329E-25	10.37482
imf5_HOS31	0.327022	7.291645	0.003475	1.384262	7.78292E-25	10.29397
imf4_Lmax	553.1594	376.4145	603.6161	448.0799	1.6702E-24	10.22012
imf1_HOS35	12.95593	258.5758	-0.2296	78.85689	1.72475E-24	10.217
imf3_HOS17	9.526542	224.2889	-0.0188	37.36479	4.32899E-24	10.12726
imf1_HOS49	-12.8617	307.5682	0.432275	55.9005	4.72432E-24	10.1187
imf5_HOS72	0.319114	7.78612	0.005847	0.838636	5.64644E-24	10.1012
imf4_HOS91	2.031381	44.94349	0.031388	9.465067	7.27807E-24	10.07625
imf2_HOS129	-9.75497	209.3961	-0.32435	46.62885	9.58669E-24	10.0491
imf5_HOS94	-0.51176	12.51063	0.001981	1.750152	1.12406E-23	10.03338
imf4_HOS6	-5.51447	123.9277	-0.10087	25.27632	2.13415E-23	9.96982
imf5_HOS43	-0.32233	7.407857	-0.00291	1.430431	2.21548E-23	9.9661
imf4_TT	3.940876	1.53107	4.155905	1.971197	2.3079E-23	9.962033
imf3_HOS6	20.22276	492.7924	-0.20651	77.95248	2.58229E-23	9.950846
imf2_HOS26	-9.92695	233.5572	0.54658	53.40054	3.1105E-23	9.932287
imf3_HOS113	-5.26301	123.6132	-0.10464	20.62285	3.25893E-23	9.927633
imf3_HOS72	4.915832	120.8116	-0.01785	17.59375	3.36804E-23	9.924343
imf5_HOS62	0.273456	6.767975	0.00405	0.792698	3.50117E-23	9.92047
imf1_HOS13	-10.6082	192.2598	-0.74536	64.75953	7.85251E-23	9.839426
imf4_HOS12	3.209973	76.79153	-0.19404	17.64214	1.1087E-22	9.804617
imf4_HOS18	1.912761	46.99507	-0.12774	10.40687	3.01798E-22	9.702871
imf2_HOS29	-15.7133	290.3373	-0.61814	104.8796	5.45746E-22	9.642188
imf5_HOS2	-2.21862	57.17043	-0.03837	6.207867	1.11929E-21	9.568103
imf3_HOS25	6.016123	150.8859	0.008321	24.66991	2.04547E-21	9.505481
imf3_HOS128	4.393919	114.3497	-0.13607	18.3637	2.47267E-21	9.485698
imf4_HOS63	-0.86092	22.16733	0.054927	4.889296	2.46217E-20	9.242694
imf4_HOS7	4.540875	114.6755	-0.26631	26.79256	2.85528E-20	9.226818
imf2_HOS70	-12.2593	276.4769	-0.5674	66.53902	2.88736E-20	9.225619
imf5_HOS8	-1.14945	30.89343	-0.01995	3.428135	5.49775E-20	9.156277
imf3_HOS18	8.71812	229.07	-0.04065	37.23084	6.55256E-20	9.137289
imf3_HOS14	11.87023	315.7697	-0.09039	50.32594	1.10108E-19	9.080914
imf1_HOS91	10.01677	166.136	0.200054	83.37948	1.37019E-19	9.057061
imf2_Approximate Entropy	1.972369	0.121809	1.95604	0.165299	1.40461E-19	9.054351
imf5_HOS22	0.763205	19.66718	0.005174	3.573331	1.8584E-19	9.023713

imf3_ENTR	1.491409	0.12627	1.475168	0.16532	2.6999E-19	8.982679
imf5_HOS63	0.249035	6.769935	0.002959	0.904286	4.25194E-19	8.932535
imf1_HOS8	-12.3963	237.928	-0.9743	87.60336	1.19011E-18	8.817868
imf1_HOS19	-7.17737	145.0689	-0.52065	48.90874	1.42744E-18	8.797459
imf1_HOS33	-5.35688	122.5324	-0.02041	37.18058	2.28933E-18	8.744224
imf1_HOS93	-9.82569	220.4151	0.046063	71.9456	2.98133E-18	8.714321
imf3_HOS9	14.39769	406.083	-0.16527	64.1901	7.50092E-18	8.609064
imf4_HOS90	1.543462	39.89129	0.036497	8.361303	1.10886E-17	8.564092
imf3_HOS3	20.64075	587.5211	-0.24257	91.98182	1.29766E-17	8.545938
imf1_HOS69	-8.55367	193.71	0.3494	69.63787	1.31766E-17	8.544169
imf5_Approximate Entropy	0.781351	0.231787	0.803774	0.239712	5.60526E-17	8.375164
imf5_HOS127	-0.24124	6.978239	0.000533	1.096882	8.59858E-17	8.324579
imf5_HOS98	0.240948	7.107917	0.004814	0.794733	9.3673E-17	8.31442
imf4_HOS97	-1.10042	31.43162	0.060432	6.871728	1.23205E-16	8.281827
imf1_HOS92	-11.4659	292.3933	-0.01186	78.64113	1.78225E-16	8.237718
imf1_HOS28	10.88955	286.4135	-0.48658	81.98182	3.33497E-16	8.162329
imf5_HOS71	0.266344	8.082676	0.006224	0.861116	6.20943E-16	8.086866
imf1_HOS41	-6.61051	199.3827	0.209742	34.47582	6.27727E-16	8.085541
imf4_HOS79	-1.90558	56.29046	0.081953	11.57104	8.87667E-16	8.043172
imf3_HOS19	7.659276	231.5889	-0.03721	37.08432	1.7246E-15	7.961348
imf3_HOS98	4.430028	136.8891	-0.08849	21.25281	1.9433E-15	7.946553
imf3_HOS13	10.38822	317.0917	-0.10369	50.47019	2.14486E-15	7.934303
imf5_HOS18	-0.41432	12.79751	-0.00725	1.517264	2.44323E-15	7.918107
imf1_HOS110	7.082766	171.5085	0.079431	56.8134	3.00365E-15	7.892363
imf3_MMSE3	0.646266	0.08761	0.654414	0.093621	5.36544E-15	7.8196
imf5_HOS95	-0.33585	10.68173	0.002576	1.452855	8.01825E-15	7.768826
imf3_HOS85	-4.14101	126.5373	-0.04258	20.4785	9.63347E-15	7.745524
imf5_HOS64	0.226229	6.99699	0.001836	1.066429	9.87276E-15	7.742404
imf1_HOS136	-8.69108	237.5668	0.357443	74.77516	5.11965E-14	7.530231
imf4_HOS25	0.75333	24.84115	-0.06927	5.171854	5.54739E-14	7.519739
imf2_HOS46	-14.3169	380.8452	-0.89323	98.90144	6.3078E-14	7.502913
imf3_HOS1	20.752	684.855	-0.22397	106.1456	1.65385E-13	7.375475
imf3_HOS5	14.96785	499.7747	-0.21684	78.22545	2.7951E-13	7.305195
imf1_HOS4	-12.5452	269.7316	-1.18308	111.128	3.25082E-13	7.284846
imf5_HOS79	-0.34609	12.12427	0.004708	1.39849	5.20107E-13	7.221176
imf4_HOS114	0.762536	22.80696	0.027361	5.099292	6.80625E-13	7.184489
imf4_HOS89	1.139247	34.90741	0.039262	7.300096	8.89602E-13	7.147789
imf5_HOS51	0.156195	5.376133	0.003059	0.635472	1.32658E-12	7.09268
imf4_HOS100	0.852343	25.94455	0.031881	5.668546	1.3278E-12	7.092553
imf5_HOS4	-1.28904	44.50336	-0.02586	5.091779	1.3602E-12	7.089215
imf2_HOS58	-10.4663	304.4185	-0.62898	72.05869	1.39931E-12	7.085288
imf5_HOS84	0.22817	7.890905	0.005427	0.86527	1.49159E-12	7.076433
imf3_HOS20	6.804407	230.7457	-0.0092	36.93795	1.51575E-12	7.074203
imf4_HOS80	-1.45627	50.19395	0.071867	10.25886	3.81878E-12	6.944832
imf3_HOS21	6.581561	226.9061	0.038704	36.89169	5.60929E-12	6.890311
imf5_HOS23	0.402416	13.68324	0.002183	2.426065	5.9843E-12	6.881094
imf3_HOS12	8.915596	314.4304	-0.0858	50.47114	7.16967E-12	6.855292

imf1_HOS42	4.081914	93.10586	0.096905	43.99886	9.19391E-12	6.819632
imf4_HOS3	-4.96404	163.89	-0.16588	32.49756	1.75202E-11	6.726326
imf5_HOS41	0.079948	2.926523	0.001986	0.318961	2.37782E-11	6.681696
imf1_HOS81	-5.92635	159.9913	0.223911	67.02858	4.5772E-11	6.585018
imf5_HOS111	-0.22444	8.372814	0.001721	1.213014	5.09556E-11	6.569051
imf5_HOS65	0.20504	7.441626	0.000682	1.259451	7.23784E-11	6.516556
imf5_HOS42	-0.12107	4.357612	-0.00041	0.773943	7.45306E-11	6.512155
imf2_HOS38	-9.30376	275.9133	-0.55808	79.50479	8.24045E-11	6.497049
imf3_HOS8	10.86147	407.8161	-0.15754	64.26269	8.65979E-11	6.48957
imf2_HOS47	-10.3437	324.4884	-0.70477	82.54296	1.93693E-10	6.367112
imf1_HOS59	-6.41543	233.7904	0.443075	58.25325	2.45613E-10	6.330554
imf1_HOS34	4.941757	141.9261	-0.14038	56.97781	3.34425E-10	6.282735
imf5_HOS70	0.216617	8.4411	0.006595	0.893221	3.98413E-10	6.255457
imf1_HOS104	6.943134	188.3549	0.260955	75.07662	4.14947E-10	6.249105
imf1_HOS5	-10.6711	267.6598	-1.38204	110.0364	1.87375E-09	6.009108
imf3_HOS2	14.63096	596.5727	-0.22642	92.40434	2.00958E-09	5.997745
imf1_HOS94	-5.25489	153.4218	0.103367	65.16989	2.94508E-09	5.935323
imf1_HOS27	5.859559	210.7841	-0.42137	66.47727	3.96944E-09	5.886138
imf5_HOS55	-0.28402	11.00159	-0.00437	2.179073	5.19594E-09	5.841433
imf4_HOS81	-1.06068	44.13124	0.062602	8.971184	6.13095E-09	5.813798
imf5_DET	0.951923	0.049655	0.948293	0.0566	6.68314E-09	5.799346
imf2_HOS37	-10.3041	331.611	-0.78511	100.706	8.37142E-09	5.761439
imf1_HOS107	-6.8848	240.2699	-0.02379	72.49976	9.14411E-09	5.746515
imf2_HOS71	5.182361	213.5709	-0.4308	51.39046	9.8448E-09	5.734007
imf4_HOS88	0.806066	30.38314	0.04039	6.348232	1.08442E-08	5.717588
imf1_HOS9	-8.31581	233.5036	-1.14619	85.75867	1.63762E-08	5.647082
imf5_LAM	0.985643	0.016019	0.984372	0.020583	1.70172E-08	5.640473
imf5_HOS80	-0.24376	11.01633	0.004781	1.26268	1.76632E-08	5.634052
imf1_HOS6	-9.65978	254.7822	-1.50615	103.3807	2.38674E-08	5.581917
imf4_HOS9	-2.3457	92.7479	-0.12303	18.70052	4.16108E-08	5.484425
imf1_HOS118	5.699125	189.3525	0.27134	64.2034	4.23916E-08	5.481136
imf1_HOS3	-11.724	322.7438	-1.72806	128.3315	4.69977E-08	5.462853
imf3_HOS11	7.030914	309.3463	-0.03879	50.39504	4.79742E-08	5.459201
imf1_HOS2	-11.7542	329.9065	-1.57365	133.712	7.23025E-08	5.385874
imf5_HOS66	0.18538	8.081288	-0.0005	1.471067	7.34885E-08	5.382946
imf4_Trans	0.747649	0.007612	0.748139	0.008236	8.74289E-08	5.351595
imf1_HOS133	4.419648	149.3397	0.228852	51.96213	1.15735E-07	5.300604
imf3_HOS28	-3.30069	156.1094	0.114271	25.21726	1.67291E-07	5.232914
imf2_HOS32	-3.4817	155.8701	0.124845	33.32165	1.80166E-07	5.219192
imf1_HOS135	-5.50388	221.7984	0.3382	70.3453	2.10422E-07	5.190354
imf5_K-S Entropy	0.30739	0.161583	0.297949	0.163399	2.47456E-07	5.160076
imf5_HOS16	0.494144	23.0204	0.000156	3.814637	3.21059E-07	5.111092
imf5_HOS12	-0.47085	22.39578	-0.01076	2.789631	3.62077E-07	5.088327
imf1_HOS108	-4.64329	164.2499	0.0154	64.52939	4.77441E-07	5.035591
imf2_HOS84	4.336562	205.0509	-0.42405	51.68175	6.00552E-07	4.991456
imf1_HOS1	-13.1951	443.5526	-1.88868	150.9793	1.14503E-06	4.865307
imf4_HOS70	0.671531	31.43312	0.025033	5.627325	1.37189E-06	4.829424

imf3_HOS4	9.891704	502.9291	-0.18177	78.31814	1.44044E-06	4.819702
imf4_HOS69	0.737428	35.09193	0.02509	6.039257	1.57109E-06	4.802347
imf3_HOS61	-1.67968	86.54617	0.024762	13.14748	1.96925E-06	4.756917
imf1_HOS106	-6.85312	310.7723	-0.0586	79.89795	3.02069E-06	4.669751
imf4_HOS61	0.463626	21.92186	0.022486	4.281525	3.50134E-06	4.639316
imf5_HOS69	0.170101	8.852711	0.00696	0.93425	3.58911E-06	4.634195
imf4_HOS82	-0.71944	38.27746	0.05472	7.749247	3.76834E-06	4.6241
imf4_HOS1	-4.53739	214.2597	-0.23325	42.42945	3.90488E-06	4.616714
imf4_DET	0.813128	0.092798	0.807448	0.112339	4.32872E-06	4.595268
imf1_HOS50	-3.8725	218.9158	0.355173	36.74552	4.45179E-06	4.589418
imf1_HOS21	4.332014	223.6536	-0.71897	69.06738	6.76384E-06	4.501296
imf3_MMSE4	0.731359	0.132822	0.738195	0.136063	7.01975E-06	4.493396
imf5_HOS54	-0.17643	8.989631	-0.00243	1.737703	7.73086E-06	4.472808
imf4_HOS19	-0.87931	42.24819	-0.07037	8.790854	1.37162E-05	4.348635
imf4_HOS98	-0.452	26.20499	0.049656	5.51261	1.45342E-05	4.335908
imf3_HOS7	7.202101	405.9663	-0.1126	64.17061	1.5243E-05	4.325422
imf4_HOS68	0.72753	38.94609	0.027147	6.500023	1.88809E-05	4.277995
imf4_HOS71	0.54111	28.21072	0.027216	5.293667	2.27266E-05	4.236526
imf4_HOS77	-0.4932	31.03919	0.069044	5.792458	2.4721E-05	4.217587
imf5_HOS96	-0.15116	9.074301	0.003249	1.177664	2.72201E-05	4.195809
imf1_HOS125	3.151179	128.4736	0.003833	54.02501	2.82252E-05	4.187583
imf4_HOS87	0.527623	26.90386	0.040676	5.608781	3.98235E-05	4.108738
imf4_HOS4	2.278236	142.3702	-0.27096	30.68432	5.57524E-05	4.030327
imf1_HOS10	-5.98497	214.451	-1.2475	80.21056	5.69765E-05	4.025218
imf5_HOS128	0.079452	4.75525	0.002427	0.601956	6.20468E-05	4.005108
imf4_K-S Entropy	0.191119	0.163267	0.198325	0.160532	6.4508E-05	3.995902
imf4_HOS78	-0.50816	34.19579	0.074135	6.159893	6.51685E-05	3.993487
imf4_Vmax	39.86933	33.03455	41.35338	35.03778	0.000143301	3.802589
imf4_HOS76	-0.40074	28.1036	0.062079	5.457701	0.000143929	3.801505
imf2_HOS113	-4.01818	209.1837	-0.38661	50.64082	0.00015663	3.780502
imf5_HOS32	0.040957	2.548549	0.000678	0.469773	0.000224934	3.689404
imf5_HOS7	-0.5278	34.82401	-0.0153	4.41863	0.000274988	3.637956
imf3_HOS26	2.312993	153.8715	0.027708	24.52342	0.000370169	3.560643
imf1_HOS120	-4.1659	257.6168	0.314227	77.72568	0.000465757	3.499864
imf5_HOS81	-0.13478	10.00407	0.00489	1.136758	0.000484919	3.4891
imf1_HOS14	-4.49816	202.4516	-0.89307	66.04565	0.000529261	3.465638
imf4_HOS113	-0.28893	22.03222	0.043506	4.656209	0.000641579	3.413538
imf4_HOS67	0.636851	42.83908	0.030755	6.984677	0.000727348	3.379193
imf4_HOS129	0.29934	18.1232	0.026949	3.994713	0.0007715	3.362956
imf4_HOS83	-0.42722	32.92638	0.0486	6.65699	0.000949991	3.30506
imf5_HOS68	0.126889	9.308605	0.007314	0.983368	0.001238332	3.23002
imf4_HOS8	1.207564	100.3788	-0.19859	21.13005	0.001512844	3.172321
imf2_HOS59	2.885154	233.3058	-0.45309	54.63132	0.00164846	3.147304
imf4_HOS72	0.362709	25.7522	0.031629	5.068213	0.003088945	2.958838
imf5_HOS83	0.101688	8.400031	0.005213	0.932144	0.004024966	2.876284
imf4_HOS33	-0.17448	11.7842	-0.02041	2.774806	0.004090358	2.871193
imf1_HOS123	-2.74959	181.3099	-0.02216	64.5459	0.004955073	2.810021

imf2_HOS39	-3.05569	210.7886	-0.32074	56.48263	0.006295331	2.732063
imf5_RTE	0.648414	0.217871	0.654953	0.215718	0.006916883	2.700892
imf4_HOS75	-0.2478	25.76405	0.054012	5.188245	0.007326059	2.681718
imf1_HOS82	2.418166	137.7262	0.270478	60.14001	0.009119635	2.607602
imf1_HOS26	-2.0993	128.0317	-0.31584	47.71846	0.010999682	2.54277
imf4_MMSE1	0.358208	0.080137	0.360905	0.099113	0.013234007	2.477466
imf4_HOS62	-0.19573	21.49798	0.03802	4.50017	0.013673152	2.465794
imf4_HOS5	-1.50581	129.2433	-0.19018	25.99635	0.019757691	2.330966
imf4_HOS86	0.285011	25.19176	0.040944	5.215302	0.027588031	2.203137
imf4_ENTR	1.655876	0.211724	1.64998	0.246063	0.029981096	2.17038
imf1_HOS95	1.9756	144.567	0.151703	60.19467	0.030101591	2.168791
imf5_HOS53	-0.06689	7.240521	-0.00054	1.310648	0.031796423	2.146999
imf1_HOS122	-2.519	240.823	-0.03669	72.54044	0.037916788	2.075789
imf5_HOS67	0.086983	9.800315	0.007656	1.039741	0.041892582	2.034619
imf3_MMSE5	0.833104	0.177053	0.837007	0.180183	0.052842031	1.936239
imf1_HOS60	1.902782	168.6906	0.410901	40.22951	0.053028028	1.934722
imf4_Sample Entropy	0.731286	0.063468	0.72952	0.083884	0.054152575	1.925643
imf4_T2	57.78293	14.82264	57.47344	15.61714	0.07542467	1.777897
imf4_HOS84	-0.17319	28.54378	0.044391	5.790878	0.081526721	1.741918
imf5_HOS52	0.04417	5.940435	0.001294	0.919279	0.082130734	1.738477
imf3_HOS33	0.633	83.14785	0.050396	13.34031	0.09334801	1.678016
imf3_RTE	0.533144	0.193267	0.529591	0.19492	0.103709238	1.62715
imf1_HOS105	2.167149	220.4613	0.258816	79.92583	0.109064833	1.602429
imf2_HOS48	-2.35959	256.7391	-0.49749	63.47832	0.116649835	1.569009
imf3_HOS27	-0.93256	155.576	0.065133	24.67857	0.123902811	1.538613
imf1_HOS134	-1.22673	193.0899	0.290307	62.16916	0.124046615	1.538025
imf4_RTE	0.598056	0.198113	0.594666	0.202854	0.134967934	1.494811
imf4_HOS99	0.193503	24.13422	0.040296	5.04285	0.149798838	1.440257
imf2_HOS98	0.940567	206.2152	-0.41613	52.30137	0.158084906	1.411555
imf5_Lmax	1402.822	547.7639	1410.499	551.5666	0.21407028	1.242461
imf5_HOS112	0.03505	6.571826	0.003044	0.836679	0.228813926	1.203429
imf1_HOS124	-0.95881	132.8891	-0.00745	57.65507	0.229484092	1.201698
imf5_HOS97	0.041433	7.821564	0.003996	0.945267	0.234359845	1.189212
imf4_HOS73	0.156645	24.41397	0.037977	4.973836	0.267158064	1.109639
imf1_HOS70	-0.5421	153.0396	0.378423	59.01599	0.280776174	1.078585
imf3_MMSE8	1.122067	0.246944	1.125085	0.257736	0.293872556	1.049671
imf4_HOS51	0.090675	16.65755	0.017457	3.391581	0.315580251	1.003588
imf5_HOS24	0.032583	8.36345	-0.00105	1.330644	0.334881493	0.964334
imf4_<L>	3.946357	0.918023	3.933635	1.214586	0.337849448	0.958429
imf3_MMSE7	1.036791	0.23394	1.039375	0.24162	0.338420479	0.957297
imf4_HOS74	-0.05457	24.43169	0.045693	5.017862	0.349768252	0.935045
imf3_MMSE6	0.938414	0.2108	0.940669	0.216004	0.350540377	0.933547
imf1_HOS20	0.165187	188.3512	-0.6463	59.08232	0.393642989	0.853034
imf4_HOS13	0.118748	67.1925	-0.13108	13.76691	0.396642363	0.847638
imf3_<L>	3.423964	0.274054	3.4303	0.762616	0.434503756	0.781512
imf5_HOS17	0.045118	16.79437	-0.00341	2.525846	0.484591708	0.69894
imf5_HOS82	-0.01948	9.118881	0.005034	1.024782	0.501310298	0.672433

imf5_HOS11	0.065627	27.83279	-0.00664	4.049652	0.527983305	0.63109
imf4_HOS2	-0.73727	175.3492	-0.26098	35.78261	0.53535878	0.619849
imf1_HOS121	-0.8533	285.332	-0.04483	78.78123	0.555050792	0.590211
imf3_MMSE1	0.487539	0.067131	0.488018	0.08378	0.602886306	0.520256
imf1_HOS119	-0.02325	232.9434	0.303538	72.99182	0.781098372	0.277889
imf2_RTE	0.514992	0.168491	0.514534	0.162332	0.802185576	0.25052
imf1_HOS15	-1.14524	198.4045	-0.97803	66.65032	0.871424733	0.16185
imf4_HOS85	0.058071	25.76881	0.041972	5.275883	0.886720274	0.142456
imf1_HOS109	0.112788	134.1267	0.051485	58.93543	0.939304507	0.076144

Appendix B: Decision Tree (DT) classification results

Table B: DT classification results

No of Features	TP	TN	FP	FN	Accuracy	PPV	Sensitivity	Specificity
2	65436	5751	3249	3164	0.917358247	0.952697095	0.953877551	0.639
3	65465	5906	3094	3135	0.919729381	0.954870987	0.954300292	0.656222222
4	65726	6063	2937	2874	0.925115979	0.957225871	0.958104956	0.673666667
5	66354	6746	2254	2246	0.942010309	0.967146688	0.967259475	0.749555556
6	66390	6765	2235	2210	0.942719072	0.967431694	0.967784257	0.751666667
7	66281	6794	2206	2319	0.941688144	0.967789507	0.966195335	0.754888889
8	66324	6776	2224	2276	0.942010309	0.967555581	0.966822157	0.752888889
9	66375	6776	2224	2225	0.942667526	0.967579702	0.967565598	0.752888889
10	66734	7162	1838	1866	0.952268041	0.973196057	0.972798834	0.795777778
11	66881	7270	1730	1719	0.955554124	0.974785384	0.974941691	0.807777778
12	66964	7460	1540	1636	0.959072165	0.977519561	0.976151603	0.828888889
13	67063	7493	1507	1537	0.960773196	0.978022459	0.977594752	0.832555556
14	67158	7572	1428	1442	0.963015464	0.979179424	0.978979592	0.841333333
15	67153	7588	1412	1447	0.963157216	0.979406403	0.978906706	0.843111111
16	67167	7572	1428	1433	0.963131443	0.979182156	0.979110787	0.841333333
17	67295	7683	1317	1305	0.96621134	0.980805107	0.980976676	0.853666667
18	67244	7693	1307	1356	0.96568299	0.980933903	0.980233236	0.854777778
19	67243	7678	1322	1357	0.965476804	0.980719026	0.980218659	0.853111111
20	67213	7663	1337	1387	0.964896907	0.980495988	0.979781341	0.851444444
21	67240	7667	1333	1360	0.965296392	0.980560862	0.980174927	0.851888889
22	67252	7665	1335	1348	0.965425258	0.98053567	0.980349854	0.851666667
23	67230	7659	1341	1370	0.965064433	0.980443628	0.980029155	0.851
24	67248	7658	1342	1352	0.965283505	0.980434466	0.980291545	0.850888889
25	67252	7653	1347	1348	0.965270619	0.980364145	0.980349854	0.850333333
26	67256	7655	1345	1344	0.965347938	0.980393872	0.980408163	0.850555556
27	67244	7668	1332	1356	0.965360825	0.980576295	0.980233236	0.852
28	67235	7669	1331	1365	0.965257732	0.980588047	0.980102041	0.852111111
29	67230	7672	1328	1370	0.965231959	0.98062954	0.980029155	0.852444444
30	67242	7668	1332	1358	0.965335052	0.980575728	0.980204082	0.852
31	67220	7671	1329	1380	0.965090206	0.980612409	0.979883382	0.852333333
32	67219	7667	1333	1381	0.965025773	0.980554907	0.979868805	0.851888889
33	67210	7658	1342	1390	0.964793814	0.98042362	0.979737609	0.850888889
34	67197	7616	1384	1403	0.964085052	0.979819484	0.979548105	0.846222222
35	67181	7604	1396	1419	0.963724227	0.979643321	0.979314869	0.844888889
36	67164	7597	1403	1436	0.963414948	0.979538262	0.979067055	0.844111111
37	67154	7591	1409	1446	0.963208763	0.979449557	0.978921283	0.843444444
38	67145	7593	1407	1455	0.963118557	0.979475435	0.978790087	0.843666667
39	67167	7579	1421	1433	0.963221649	0.97928209	0.979110787	0.842111111
40	67162	7583	1417	1438	0.963208763	0.979337698	0.979037901	0.842555556
41	67152	7582	1418	1448	0.96306701	0.979320403	0.978892128	0.842444444
42	67148	7586	1414	1452	0.96306701	0.979376331	0.978833819	0.842888889
43	67144	7585	1415	1456	0.963002577	0.979360842	0.97877551	0.842777778
44	67147	7602	1398	1453	0.963260309	0.979604639	0.978819242	0.844666667

45	67148	7605	1395	1452	0.963311856	0.979647812	0.978833819	0.845
46	67148	7605	1395	1452	0.963311856	0.979647812	0.978833819	0.845
47	67148	7601	1399	1452	0.963260309	0.979590646	0.978833819	0.844555556
48	67148	7592	1408	1452	0.96314433	0.979462046	0.978833819	0.843555556
49	67148	7591	1409	1452	0.963131443	0.979447759	0.978833819	0.843444444
50	67144	7592	1408	1456	0.963092784	0.979460847	0.97877551	0.843555556

Appendix C: K-nearest Neighbor (KNN) classification results

Table C: KNN classification results

No of Features	TP	TN	FP	FN	Accuracy	PPV	Sensitivity	Specificity
2	66367	5898	3102	2233	0.93125	0.955346989	0.96744898	0.655333333
3	66332	6119	2881	2268	0.933646907	0.958374872	0.966938776	0.679888889
4	66427	6422	2578	2173	0.938775773	0.962640388	0.968323615	0.713555556
5	66848	7147	1853	1752	0.953543814	0.973028049	0.974460641	0.794111111
6	66843	7150	1850	1757	0.953518041	0.97306858	0.974387755	0.794444444
7	66842	7142	1858	1758	0.953402062	0.972954876	0.974373178	0.793555556
8	66847	7143	1857	1753	0.953479381	0.972971006	0.974446064	0.793666667
9	66831	7161	1839	1769	0.953505155	0.973219747	0.974212828	0.795666667
10	67248	7510	1490	1352	0.963376289	0.978323489	0.980291545	0.834444444
11	67327	7667	1333	1273	0.966417526	0.980585494	0.981443149	0.851888889
12	67655	7858	1142	945	0.97310567	0.983400439	0.98622449	0.873111111
13	67662	7865	1135	938	0.973286082	0.983502188	0.986326531	0.873888889
14	67738	8003	997	862	0.976043814	0.985495017	0.987434402	0.889222222
15	67740	8004	996	860	0.976082474	0.985509777	0.987463557	0.889333333
16	67739	8005	995	861	0.976082474	0.985523904	0.98744898	0.889444444
17	67754	8005	995	846	0.976275773	0.985527062	0.987667638	0.889444444
18	67754	8006	994	846	0.97628866	0.985541398	0.987667638	0.889555556
19	67753	8007	993	847	0.97628866	0.985555523	0.987653061	0.889666667
20	67756	8008	992	844	0.976340206	0.985570489	0.987696793	0.889777778
21	67821	8021	979	779	0.977345361	0.985770349	0.988644315	0.891222222
22	67820	8021	979	780	0.977332474	0.985770142	0.988629738	0.891222222
23	67818	8018	982	782	0.977268041	0.985726744	0.988600583	0.890888889
24	67816	8013	987	784	0.977177835	0.985654695	0.988571429	0.890333333
25	67810	8015	985	790	0.977126289	0.985682099	0.988483965	0.890555556
26	67805	8012	988	795	0.977023196	0.985638074	0.988411079	0.890222222
27	67801	8012	988	799	0.976971649	0.985637239	0.98835277	0.890222222
28	67808	8014	986	792	0.977087629	0.985667355	0.98845481	0.890444444
29	67800	8013	987	800	0.976971649	0.985651359	0.988338192	0.890333333
30	67801	8010	990	799	0.976945876	0.985608583	0.98835277	0.89
31	67798	8013	987	802	0.976945876	0.985650941	0.988309038	0.890333333
32	67797	8013	987	803	0.97693299	0.985650733	0.988294461	0.890333333
33	67789	8014	986	811	0.976842784	0.985663395	0.988177843	0.890444444
34	67788	8013	987	812	0.97681701	0.985648855	0.988163265	0.890333333
35	67777	8013	987	823	0.976675258	0.985646559	0.988002915	0.890333333
36	67781	8016	984	819	0.976765464	0.985690395	0.988061224	0.890666667
37	67779	8019	981	821	0.976778351	0.985732984	0.98803207	0.891
38	67773	8020	980	827	0.976713918	0.985746077	0.987944606	0.891111111
39	67776	8024	976	824	0.976804124	0.985804049	0.987988338	0.891555556
40	67781	8025	975	819	0.976881443	0.985819419	0.988061224	0.891666667
41	67778	8026	974	822	0.97685567	0.985833139	0.988017493	0.891777778
42	67779	8024	976	821	0.976842784	0.985804669	0.98803207	0.891555556
43	67781	8024	976	819	0.976868557	0.985805082	0.988061224	0.891555556
44	67778	8026	974	822	0.97685567	0.985833139	0.988017493	0.891777778

45	67777	8024	976	823	0.97681701	0.985804256	0.988002915	0.891555556
46	67781	8026	974	819	0.97689433	0.985833758	0.988061224	0.891777778
47	67782	8026	974	818	0.976907216	0.985833964	0.988075802	0.891777778
48	67783	8028	972	817	0.976945876	0.985862846	0.988090379	0.892
49	67778	8025	975	822	0.976842784	0.985818801	0.988017493	0.891666667
50	67775	8024	976	825	0.976791237	0.985803843	0.987973761	0.891555556

Appendix D: Linear discriminant analysis (LDA) classification results

Table D: LDA classification results.

No of Features	TP	TN	FP	FN	Accuracy	PPV	Sensitivity	Specificity
2	65284	6828	2172	3316	0.929278351	0.967801233	0.951661808	0.758666667
3	64433	7323	1677	4167	0.924690722	0.974633187	0.93925656	0.813666667
4	63869	7563	1437	4731	0.920515464	0.977995896	0.931034985	0.840333333
5	63757	7721	1279	4843	0.921108247	0.980333969	0.929402332	0.857888889
6	64089	7385	1615	4511	0.921056701	0.975420066	0.934241983	0.820555556
7	64264	7142	1858	4336	0.920180412	0.971900426	0.936793003	0.793555556
8	64316	7097	1903	4284	0.920270619	0.971262024	0.93755102	0.788555556
9	64485	6964	2036	4115	0.920734536	0.969393124	0.940014577	0.773777778
10	64726	7356	1644	3874	0.928891753	0.975229772	0.943527697	0.817333333
11	64469	7398	1602	4131	0.926121134	0.975753356	0.939781341	0.822
12	64380	7423	1577	4220	0.925296392	0.976090483	0.938483965	0.824777778
13	64615	7257	1743	3985	0.926185567	0.973733386	0.941909621	0.806333333
14	64423	7274	1726	4177	0.923930412	0.973907391	0.939110787	0.808222222
15	64423	7274	1726	4177	0.923930412	0.973907391	0.939110787	0.808222222
16	64422	7276	1724	4178	0.923943299	0.973936444	0.93909621	0.808444444
17	64585	7169	1831	4015	0.924664948	0.972431342	0.941472303	0.796555556
18	64697	7080	1920	3903	0.92496134	0.971178528	0.943104956	0.786666667
19	64803	6996	2004	3797	0.925244845	0.970003143	0.944650146	0.777333333
20	64900	6923	2077	3700	0.925554124	0.968989355	0.94606414	0.769222222
21	64753	6910	2090	3847	0.923492268	0.968732702	0.943921283	0.767777778
22	64847	6866	2134	3753	0.924136598	0.968140219	0.945291545	0.762888889
23	64953	6819	2181	3647	0.924896907	0.967512736	0.946836735	0.757666667
24	65041	6783	2217	3559	0.92556701	0.967037378	0.948119534	0.753666667
25	65130	6747	2253	3470	0.92625	0.966564267	0.94941691	0.749666667
26	65235	6700	2300	3365	0.926997423	0.965943585	0.950947522	0.744444444
27	65335	6659	2341	3265	0.927757732	0.965408712	0.952405248	0.739888889
28	65333	6659	2341	3267	0.927731959	0.96540769	0.952376093	0.739888889
29	65417	6615	2385	3183	0.928247423	0.964824046	0.953600583	0.735
30	65493	6568	2432	3107	0.928621134	0.964195804	0.954708455	0.729777778
31	65571	6526	2474	3029	0.929085052	0.963641708	0.955845481	0.725111111
32	65649	6487	2513	2951	0.929587629	0.96313195	0.956982507	0.720777778
33	65735	6451	2549	2865	0.930231959	0.962670611	0.958236152	0.716777778
34	65788	6416	2584	2812	0.930463918	0.962206751	0.959008746	0.712888889
35	65854	6366	2634	2746	0.930670103	0.961540708	0.959970845	0.707333333
36	65900	6330	2670	2700	0.930798969	0.961061689	0.960641399	0.703333333
37	65972	6285	2715	2628	0.931146907	0.96047287	0.961690962	0.698333333
38	66041	6226	2774	2559	0.931275773	0.959689021	0.962696793	0.691777778
39	66100	6185	2815	2500	0.931507732	0.959152579	0.963556851	0.687222222
40	66152	6141	2859	2448	0.931610825	0.958571822	0.964314869	0.682333333
41	66220	6086	2914	2380	0.931778351	0.957849973	0.965306122	0.676222222
42	66294	6055	2945	2306	0.932332474	0.957466168	0.96638484	0.672777778
43	66342	6024	2976	2258	0.932551546	0.957067428	0.967084548	0.669333333
44	66401	5978	3022	2199	0.932719072	0.956469758	0.967944606	0.664222222

45	66450	5939	3061	2150	0.932847938	0.955963804	0.968658892	0.659888889
46	66507	5910	3090	2093	0.933208763	0.955601535	0.969489796	0.656666667
47	66559	5866	3134	2041	0.933311856	0.955031352	0.970247813	0.651777778
48	66596	5820	3180	2004	0.933195876	0.95442559	0.970787172	0.646666667
49	66646	5775	3225	1954	0.933260309	0.953843512	0.971516035	0.641666667
50	66693	5730	3270	1907	0.933286082	0.953261009	0.972201166	0.636666667