3D printing of multi-material footwear & textiles for fashion application

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NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

MAE22087 – 3D Printing of Multi-Material Footwear & Textiles for Fashion Application

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INTRODUCTION Building the sole

We often struggle to find shoe sizes with the perfect fit, **customised for our feet**. Moreover, textiles are **essential elements** of traditionally manufactured footwear. Due to **chemical-intensive processes during textile production** (Madhav et al., 2018), footwear manufacturing has become an **indirect contributor to climate change.**

With **3D printing technology** evolving, **achieving the ideal fit** is within reach. Furthermore, **3D printed textiles & fabrics** have presented itself as a possible solution to **reducing pollution** by serving as a **sustainable alternative** or **replacement** for traditional textiles used in footwear manufacturing.

AIMS

1. **To 3D print an entire shoe, with multi-material components, in one process.**
2. **To evaluate the aesthetic value of 3D printed footwear & textiles for potential fashion application.**
3. **Integrate aims 1 & 2 to produce a credible shoe for the fashion industry.**

METHODOLOGY Establishing support

ARBURG FREEFORMER 300-3X

- Additive manufacturing
  - **material jetting**
- prints **combinations of hard & soft** structures
  - rapid prototyping & flexible designs

Materials

1. **TPU/TPE** - Thermoplastic Polyurethane/Elastomer
   - high abrasion/chemical resistance & flexible
2. **PC** - Polycarbonate
   - heat resistant, strong & durable
3. **Armat 11** - **Support** material
   - water-soluble

Types of **textiles**

- silk
- cotton/cellulose
- nylon

Figure 1: Textiles used in this study.

EXPERIMENTAL - PROTOTYPING

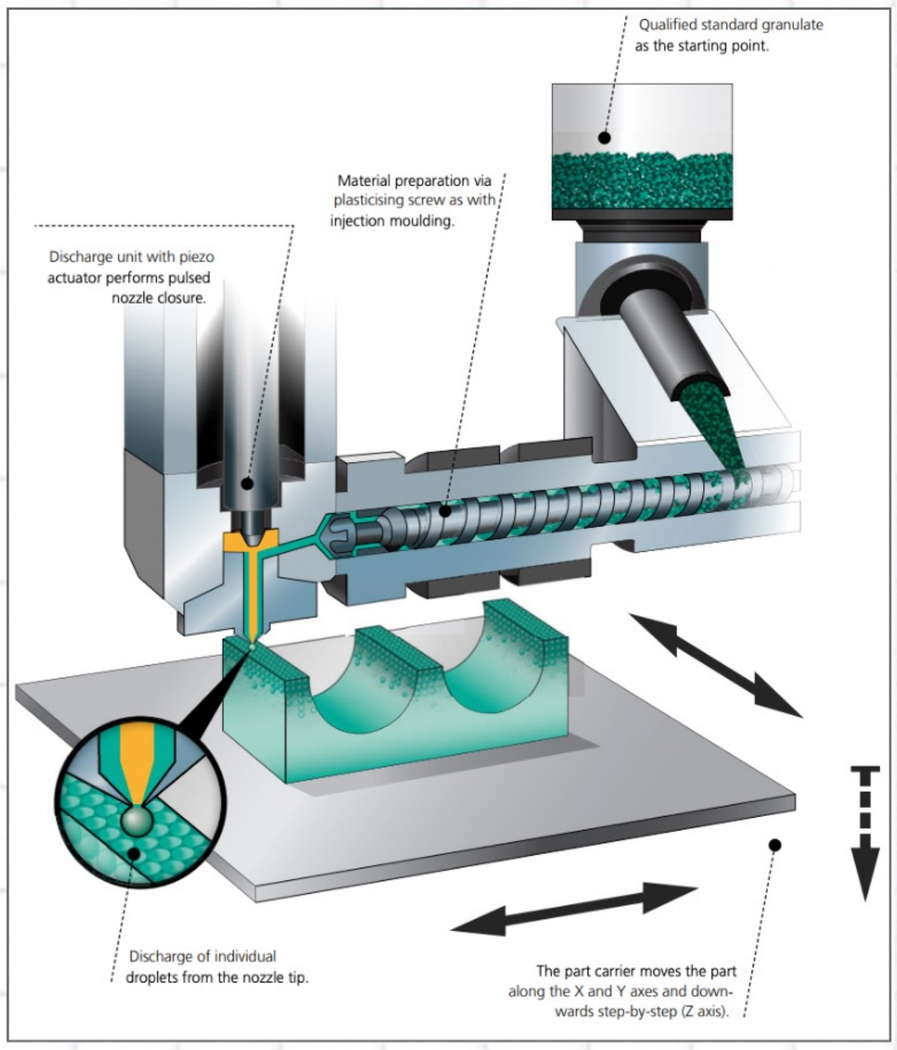

Figure 2: Operational process of Arburg Freeformer.

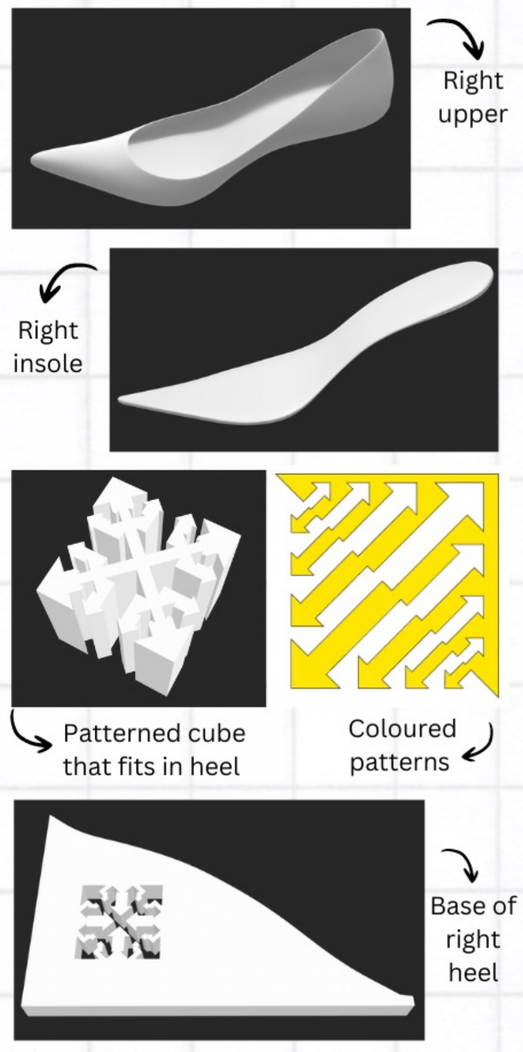

Figure 3: CAD design models of high heel.

RESULTS Work in progress...

- **3D printed fabric**
  - similar characteristics to textiles - stretchy & flexible
  - uneven surfaces

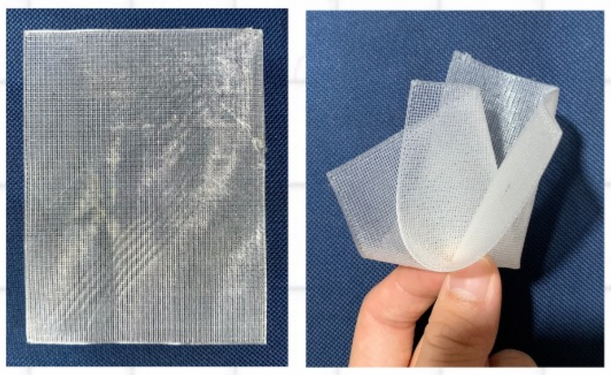

Figure 4: Sample piece of printed TPU fabric.

- **Prototype of entire high heel**

Figure 5: Prototype of high heel and patterns printed with the SLS printer in TPU.

- **Precision of details**
  - uneven layers
  - angular corners
  - untidy prints

Figure 6: Closeup of edges of a printed pattern.

- **Integrating hard & soft materials**
  - uneven & fibrous finishing

Figure 7: Flexible upper (TPE) & hard sole (PC) printed with the Arburg Freeformer.

Soft upper

FUTURE WORK Stepping up

1. Print **on textiles** and explore their **compatibility.**
2. Determine **functionality** of printed fabric as a **sustainable alternative** to textiles.
3. Print an **integrated shoe** with **hard & soft** materials e.g. using PC for the sole & TPU for the upper
4. Print a preliminary shoe design for future Miss Universe Singapore winner.

REFERENCES Backing it up

- Madhav, Sughosh, et al. "A review of textile industry: Wet processing, environmental impacts, and effluent treatment methods." Environmental Quality Management 27.3 (2018): 31-41.
- Arburg. (2022). [Process and Technology: Unique]. Arburg Freeformer Brochure. Retrieved from https://www.arburg.com/fileadmin/redaktion/mediathek/prospekte/arburg_freeformer_680836_en_gb.pdf