3D Printing Individual Insoles

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Intro

Implementing 3D Printing in the Production Process for Footbeds

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The overall problem to be addressed

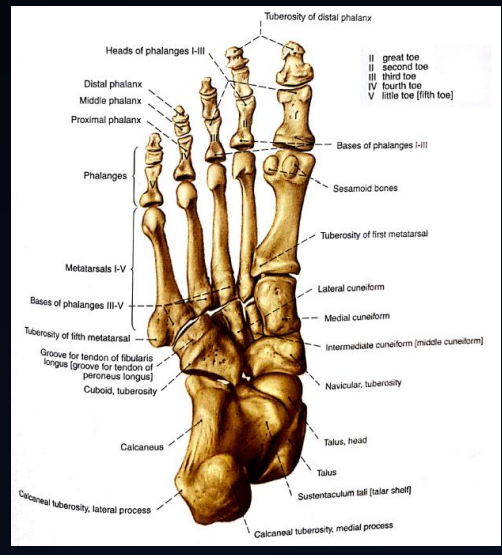
Can 3D printing be used in an effective way to make individual insoles or parts of it with satisfactory properties?

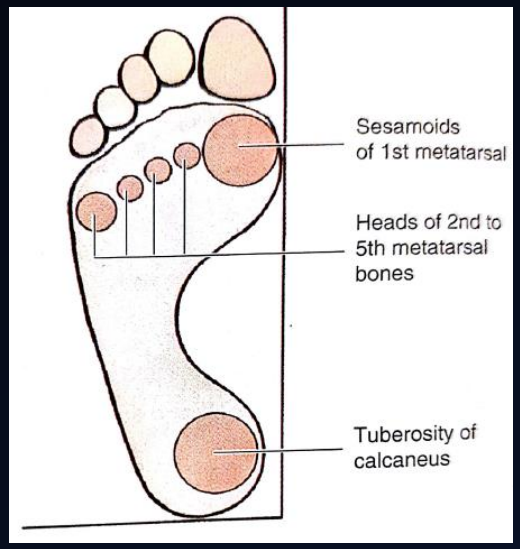
How was the problem approached?

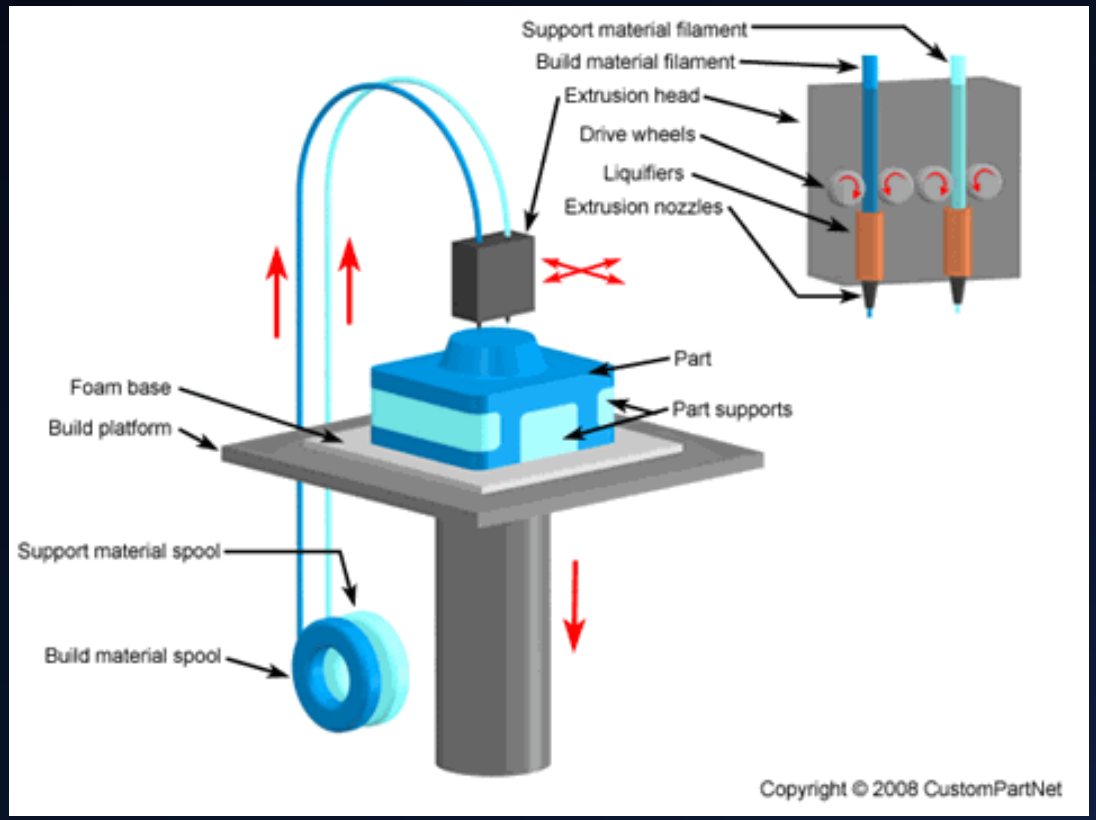
- Acquiring knowledge
- Empathizing
- Prototyping
- State of the art
- Requirements
- Testing different filaments
- Structure
- Solution
- Further work

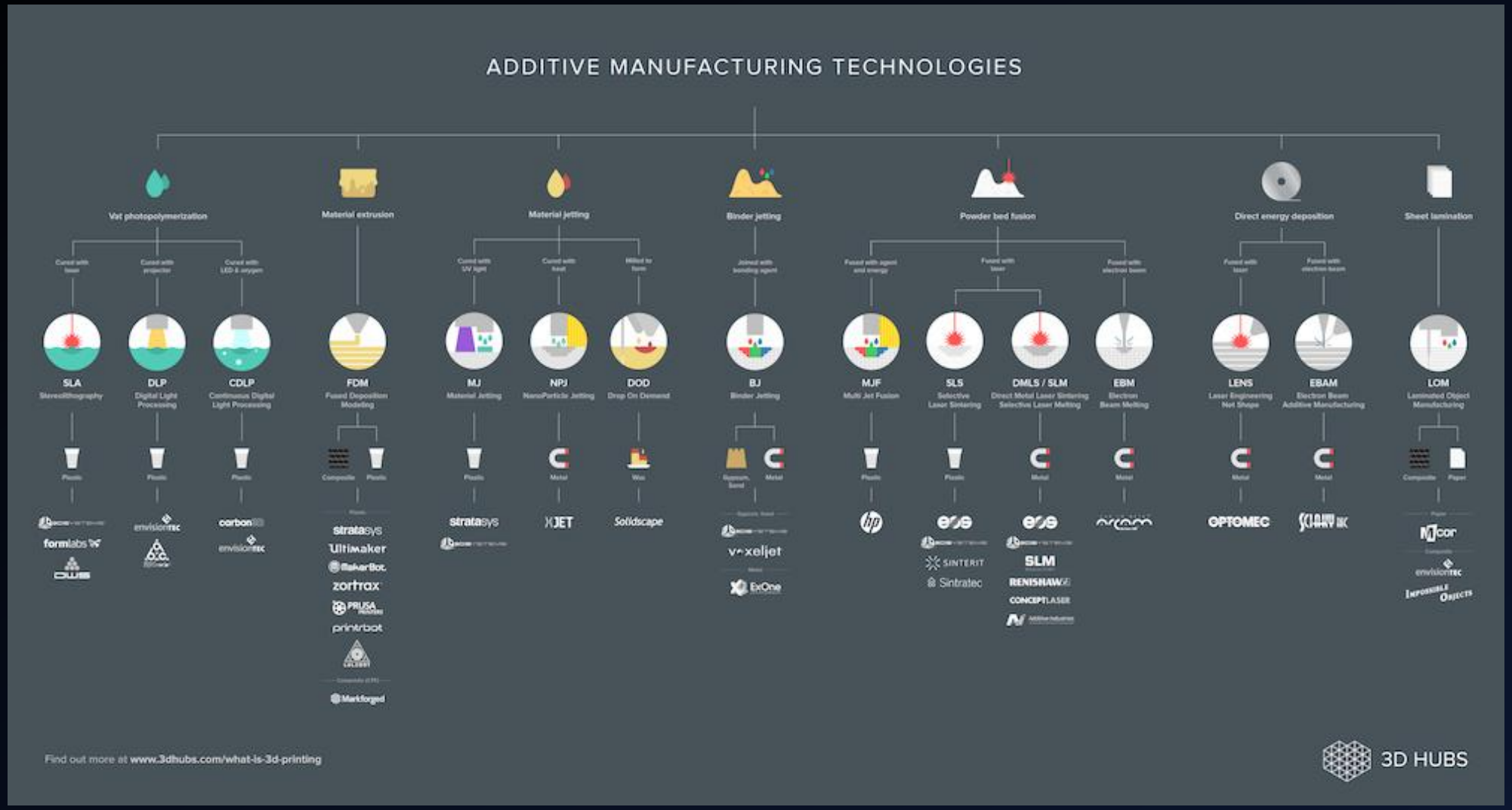
Acquiring knowledge

- The anatomy and illnesses of the foot
- Foot orthoses
- Additive manufacturing
- 3D printing techniques








ADDITIVE MANUFACTURING TECHNOLOGIES
Vat photopolymerization
Material extrusion
Material jetting
Binder jetting
Powder bed fusion
Direct energy deposition
Sheet lamination
SLA
DLP
CDLP
FDM
MJ
NPJ
DOD
BJ
MJF
SLS
DMLS / SLM
EBM
LENS
EBAM
LOM
Find out more at www.3dhubs.com/what-is-3d-printing
3D HUBS

Empathizing

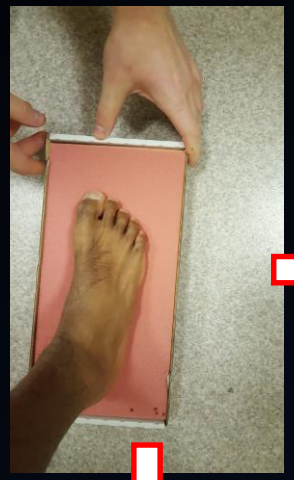
- Observe, engage, watch and listen
- Making insoles
- Disadvantages:

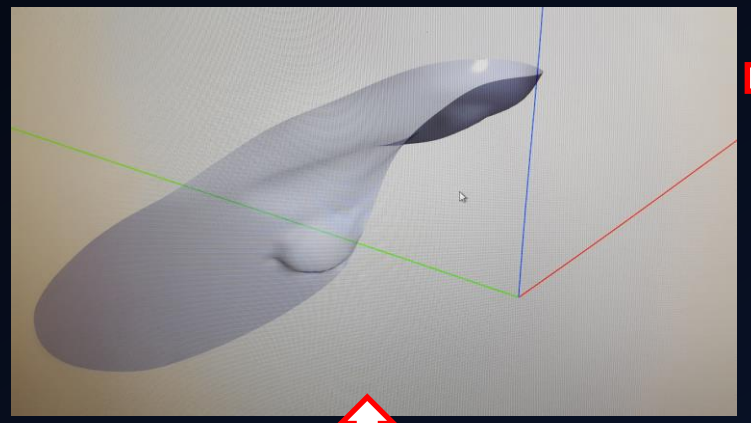
- Time

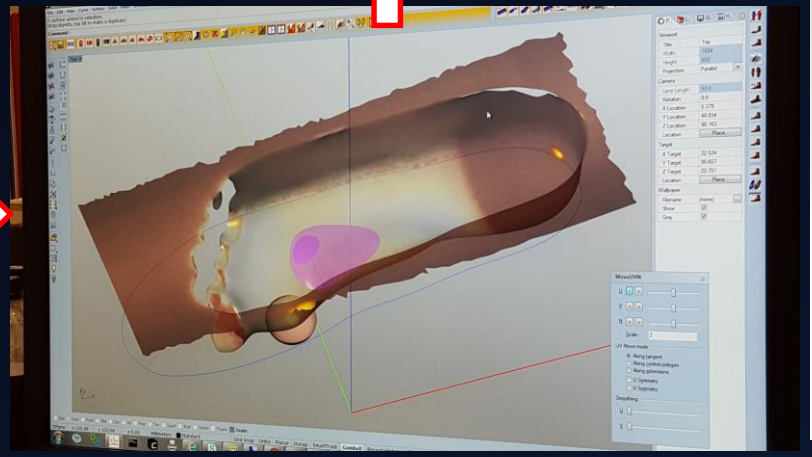
- Preciseness

- Waste

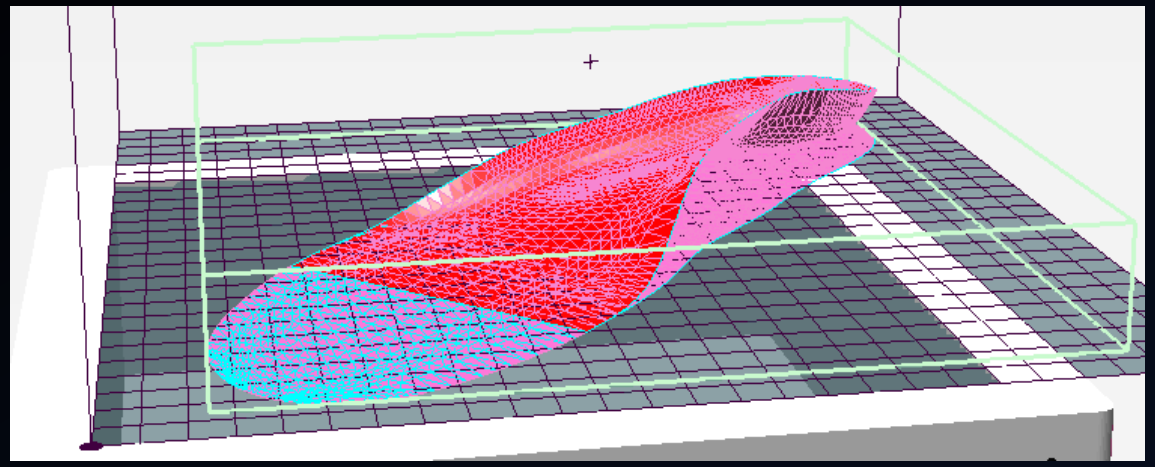
- Complexity

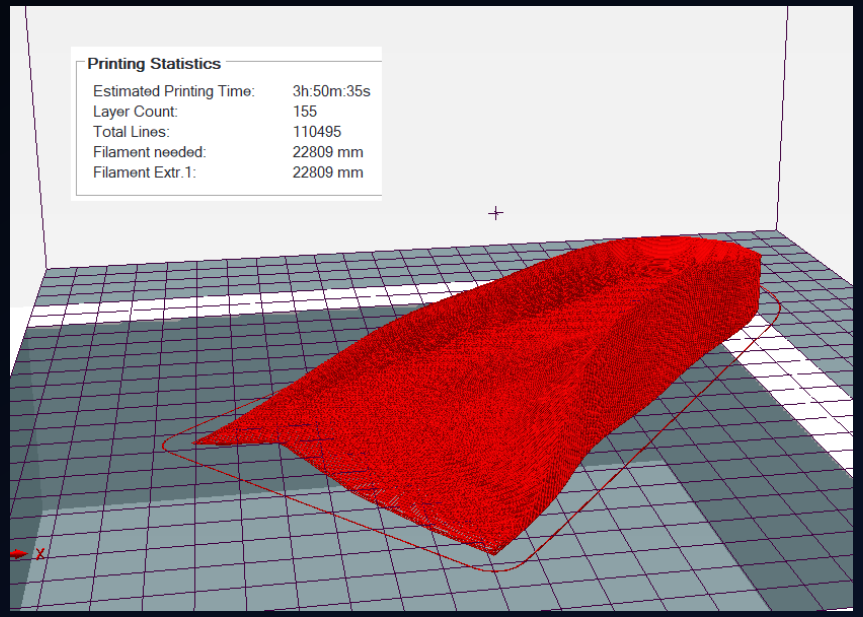


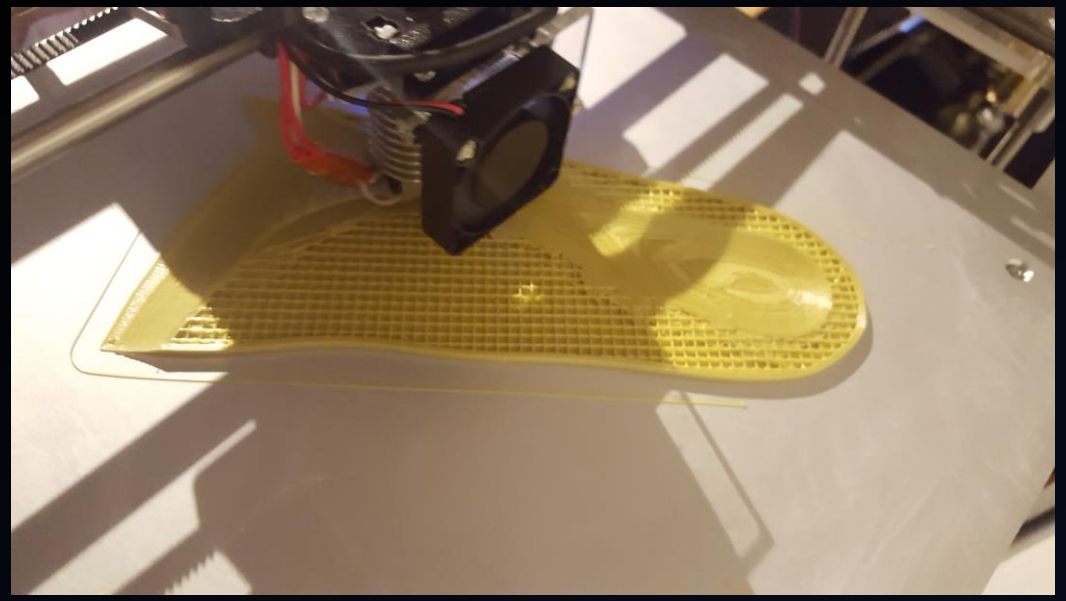




Prototyping








ASICS

State of the art

Requirements

- Adapt to a prominent skeletal part without resistance
- A fast recover to the original shape after compression
- Have contact with as much surface as possible
- Not give a "bottom out". Insoles that loose their elasticity, get thin and compressed. This means they have lost their characteristic properties.
- Relieve/inhibit shear stresses which arise during movement
- Hygienic
- Lightweight
- Durable
- Corrective
- Shock absorbent

Materials currently used to make an insole

- Leather
- Cork
- Thermoplastic plastic materials ✓
- Soft insoles
- Hardened plastic
- Braced materials in plate-shape
- Adhesive

Testing different filaments

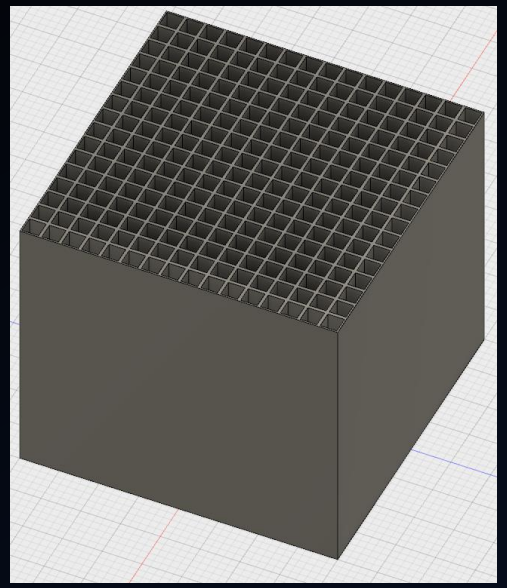
(a) Cheetah, Shore hardness: 95A.

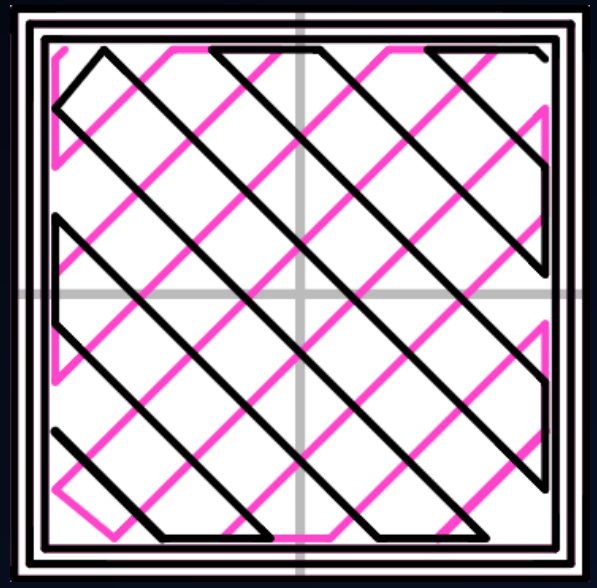
(b) NinjaFlex, Shore hardness: 85A.

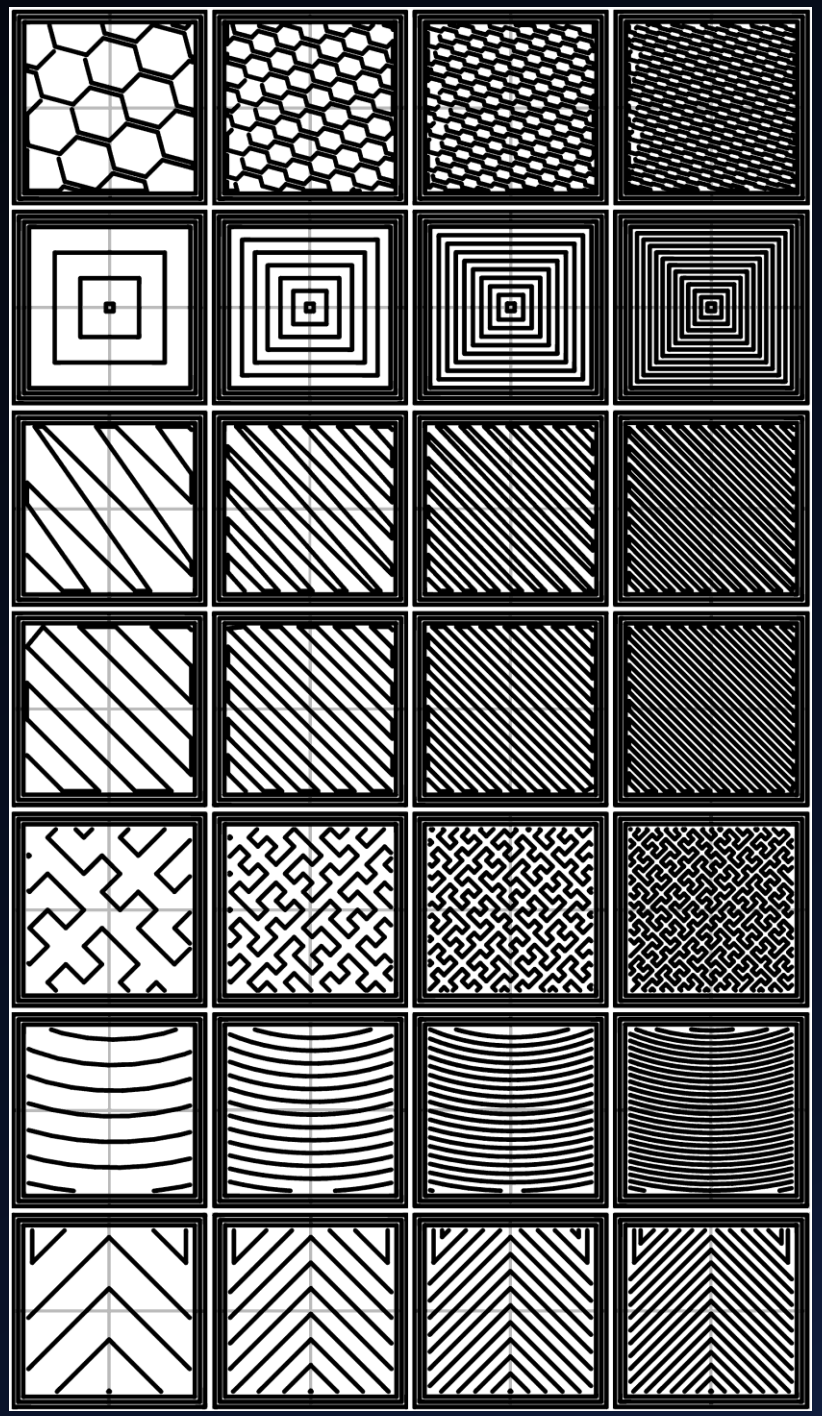
(c) Armadillo, Shore hardness: 75D.

(d) PrimaSELECT Flex, Shore hardness: 45D.

Structure







Solution

1. Find out what type of 3D printer
2. Choose a suitable 3D-printing material
3. Perform compression and hardness tests
4. Find Young’s modulus and shore hardness values
5. Draw a test-element in a CAD-software
6. Test the element by varying parameters
7. Perform tests until similar values for Young’s modulus and shore hardness are achieved.

8. Find a mathematical expression $E = f(T, S, AI, IS)$
9. 3D print test-element
10. Perform the same tests as in step 3 and control if the obtained values are similar to the ones obtained from the simulation software.
11. If the values are similar, 3D print the insoles with the obtained values for the total structure. If not, try to change the structure or printing material.
12. Test if the insoles feel the same as the current ones
13. If changes need to be executed, change softness and hardness in the required areas and use the expression from step 8 to obtain values for the material properties.

Further work

- Conduct more material tests
- Test other types of 3D printers
- Conduct more research on geometrical properties
- Conducting research on how to find material properties if the insoles is consisting of different type of materials.
- The exterior part of the insole plays an important role as well

Sources

- Aga, J. H. (2012), *Kompendium - Emne 5: Ortpediske hjelpemidler til foten - Del 1 Fotortoser*, Kopinor - Avdeling for helsefag
- Sivarajah, N. (2018). *Implementing 3D Printing in the Production Process of Individual Insoles*. Trondheim: NTNU.

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