Tailoring Poisson's Ratio of a Fabric using Auxetic Structures

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Sporting Personal Protective Equipment (PPE) & Issues with It

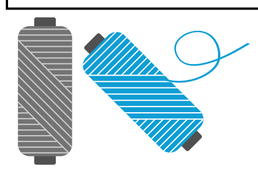
PPE is used across all contact sports and widely used by all levels - amateur to professional and across all age groups.

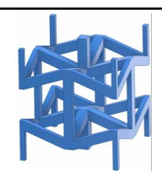
Poor Fit:
Most PPE is designed on a "one size fits all" or male-centric basis. Can lead to discomfort,, and even safety hazards with different body shapes.

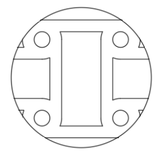
Inadequate Protection:
Generic designs do not adequately protect specific areas vulnerable during certain sports for women (e.g., chest protection in contact sports).

Discomfort and Performance:

Ill-fitting or bulky PPE can cause chafing, overheating, and hinder athletic performance.







Evolution of Fabrics

Early Fabrics (Natural)

- From animal skins to plant fibres like cotton and wool, early clothing focused on basic protection and comfort.

Industrial Revolution

- Power looms and cotton gins revolutionised textile production, making fabrics more affordable and diverse.
- Sports adopted these materials for basic uniforms and early sports equipment (e.g., leather balls).

Synthetic Revolution

- Nylon, polyester, and other synthetics emerged, offering superior qualities like durability, moisture-wicking, and lightweight construction.
- Sportswear became more specialised for different activities.

Tech Fabrics

- Advanced materials like performance blends, seamless construction, and climate control technologies are pushing the boundaries of comfort, performance, and recovery in sports apparel.

3D Printing

1980s:

- UV laser turn liquid resin into 3D objects (SLA).

1990s:

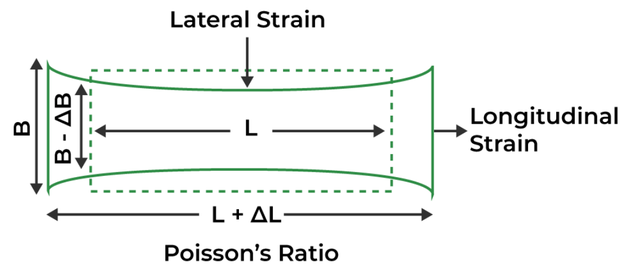
- FFF makes plastic prototypes from spools of filament.

2000s-Onwards:

- Affordable printers, new materials, and wider uses. Makes it accessible for the public.

Auxetic Structures and Poisson's Ratio

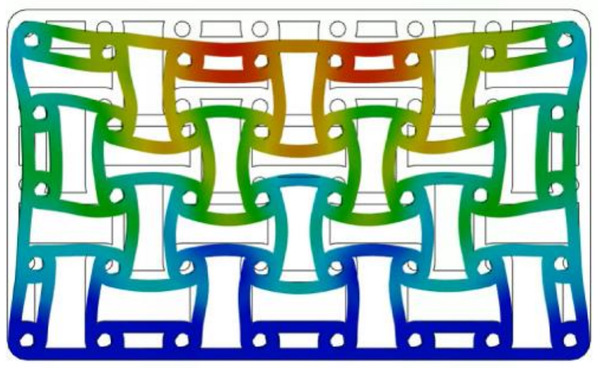
Poisson's Ratio:
Describes the relationship between strain in different directions.
Auxetic Structures have a negative Poisson's ratio, defying the typical positive value for most materials.



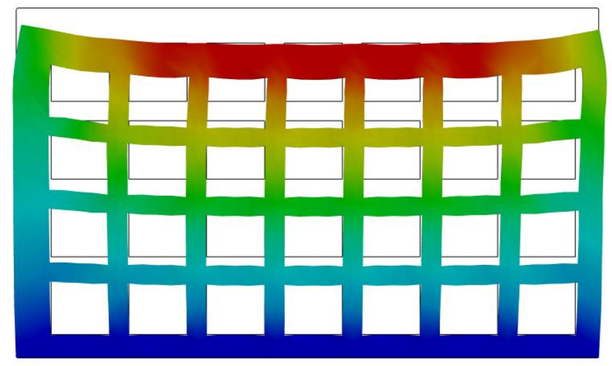
3D Printed Structures

Pick them up – Squeeze and see if you notice the difference between an Auxetic and a Non-Auxetic Structure

Auxetic



Non-Auxetic



What we are trying to do:

The project aims to try and improve the performance of PPE by:

- Creating a PPE design that can be embedded into a fabric.
- Optimising the fit of PPE/Clothing for all body types.
- Providing a base which would inform future 3D printing on fabric.

How are we doing this:

- Tailoring the printing parameters for material – fabric combinations
- Finding potential applications to improve PPE fit
- Optimising adhesion between material and fabric
- Testing its impact on the environment in terms of micro/nano plastics

Feel free to stretch the samples and note any difference

Fabric

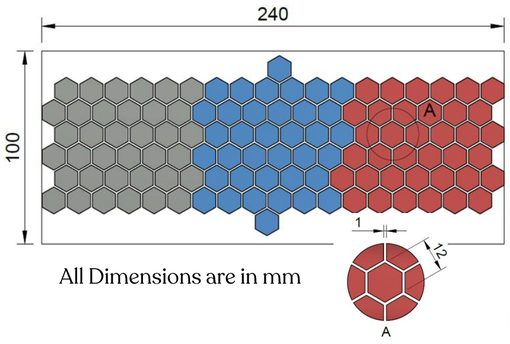
Fabric + Mesh Soft TPE

Please handle these samples with Care.

Fabric + Auxetic Soft TPE

Fabric + Auxetic Hard TPU

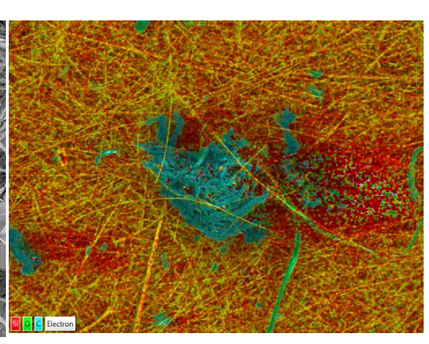
Active research studies



All Dimensions are in mm

Printing Setup on Fabric for testing

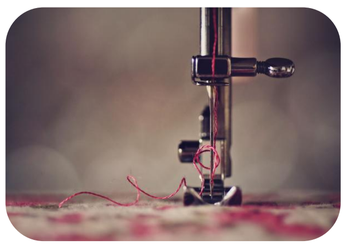
SEM Scan for Surface Finish



EDS to see Micro/Nano Plastics

Printing on Fabric for assessing adhesion, SEM Structural study and Environmental Impact

Applications and Future Work



Tailormade for purpose

Fit for any requirement

Sustainable

Contact Details:
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Outputs & References

For more information on the work being done and related information, please scan this QR Code