

## Machine and process development for 3D printing on pre-stretched textiles

### Objective

3D printing on defined pre-stressed textile substrates creates numerous new opportunities for applications. The term “4D printing” is also used here, as the material composite is deformed after being stretched. However, textile fabric tension in combination with 3D printing has not yet been sufficiently considered. As a result, it has not been possible to guarantee homogeneous, warp-free and adjustable fabric tension.

The aim of the research project was the development of machines and processes for 3D printing on pre-stretched textiles with subsequent moulding effects.

### Approach and results

The project focused on the development and construction of a size-adjustable multi-axis stenter frame for the defined tensioning of stretchable textiles. The developed system allows textiles to be tensioned with precisely adjustable forces in both the longitudinal and transverse directions. The tensioned textiles can be removed from the frame in two defined frame sizes – 50x50 cm or 32.8x24.8 cm – and subsequently functionalised using 3D printing.

A key focus of the project was the further development of the technology for partial stiffening 3D printing on pre-tensioned textiles with subsequent shape-changing effects. For this purpose, a polyamide-elastane knit was used, which was printed with PLA filament. In the course of extensive experimental testing, shape-changing effects were systematically examined as a function of stretch. The results led to the development of various demonstration samples that illustrate the potential of this novel manufacturing technology. These included, for example, innovative lamp designs and acoustic panels.



Lampshades developed in the project (left), sample of pre-stretched textile (centre) after being processed on a stenter frame (right; © STFI/Dirk Hanus)

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