Longterm Behaviour of graded CNC knitted Bending Active Textile Hybrids under real world conditions

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Abstract

CNC knitted membranes provide a promising alternative to the traditionally woven materials in textile architectures, as they allow for bespoke material performance, sustainable and efficient production and integration of functionality in the material itself [1]. However the inherent elasticity of knit and non-linear behaviour under load makes it hard to predict the mechanical performance of the material. There is especially a lack of knowledge in terms of long term behaviour of the material under stress and outdoor conditions for CNC knitted structures in architectural scale.

The currently largest application of CNC knit - the Bending Active Textile Hybrid *Isoropia* (Fig.1) [2] which was installed during the Venice Biennale 2018 - provided an opportunity to monitor and evaluate the behaviour of a custom made knit structure over a period of 8 month with 150.000 visitors and storm events.

In order to steer the material behaviour of Isoropia we have developed a new knit structure, using a fibre (Dyneema™ by DSM), which hardly elongates under load. We assume, that the elasticity of the knit is hence only triggered on loop level. The monitoring of the behaviour of Isoropia focused hence on both the global structural, as well, as the behaviour on material scale.

Geometrical differences between the build and the simulated shape of the installation are analysed shortly after installation and over the span of 8 month. We investigate both local and global deviations on the base of 3d laser scans. For this investigation we developed a set of software tools, within our open source point cloud plugin Volvox [2]. The impact of loads and environmental factors, such as UV are examined through knitted samples taken from the installation. We conduct both comparative load tests on the knit, as well as microscopic analysis on fibre level.

The analysis is ongoing at the moment. Preliminary results show, that the material is resistant to stress and environmental impact on yarn level. On loop level creep could be observed in the first weeks of installation in areas of high stress. However this did neither impact overall performance nor was it critical on local level over the monitored period.

References

[1] Thomsen et al. (2016). Knit as bespoke material practice for architecture. In POSTHUMAN FRONTIERS: Data, Designers, and Cognitive Machines. ACADIA conference proceedings

[2] La Magna et al. (2018). Isoropia: an Encompassing Approach for the Design, Analysis and Form-Finding of Bending-Active Textile Hybrids. IASS conference proceedings.