

## Project proposal for SIM ICON call

### Title

High-fidelity simulation-based platform to improve textile materials, textile manufacturing and textile connections

### Type of project

ICON – 3 years

### Partners

Flemish industrial partners:

- Picanol
- Sioen
- Vandewiele
- Siemens Industry Software NV

Academic partners:

- Ghent University, Centre for Textile Science and Engineering (UGent-CTSE)
- Ghent University, Mechanics of Materials and Structures (UGent-MMS)

### Project summary

The textile industry is a major sector in Flanders with multiple companies that are world leaders in their field and are at the forefront of textile innovation. One key challenge is the continuous search for increased performance of both products and processes. For example, suboptimal manufacturing design leads to decreased manufacturing speed or even lower properties of end-products due to production-induced flaws. Due to the complex behaviour and wide range of materials, manufacturers often have to rely on past experience, operator feel and resource-intensive experimental campaigns to improve. Other sectors have tackled similarly complex problems through the use of simulation techniques, for example the multi-scale modelling techniques encountered in the composite industry. While simulation methods for textiles have been in development for some time, they find limited use in an industrial setting as they often lack sufficient resolution and ease of use. The virtual fibre modelling method approaches the problem differently by modelling textiles with fibre-scale resolution and allowing mechanical and kinematical simulations of both products and processes at reasonable computation times. This could unlock virtual design and prototyping for textile industry, enabling increased performance of both products and processes.

The goal of this project is to create a platform for users which enables the design and optimization of textile products and processes through mechanical simulations using a virtual fibre simulation framework. The industrial partners have a joint interest to extend the current simulation efforts, coupling it both to textile manufacturing as well as as-manufactured technical textile products. This entails static and dynamic material behaviour as well as manufacturing faults and material failure. For this high fidelity simulations are developed *from yarn to fabric*, and allow to go *from process to performance*. The simulation methodology is implemented in (commercial) finite element software allowing to make full use of current state-of-the-art FE software as well as integrate the textile models into most virtual engineering workflows already present (e.g. machine component modelling). Through virtual prototyping and insights gained from simulations, better textile materials, manufacturing processes and textile connections can be designed, allowing a more quantitative and science-based engineering approach.

Sioen has extensive expertise in working with technical textiles and turning fabrics into large-scale products by confectioning and connecting parts together. They design advanced textile connections that can be made through stitching, welding, gluing and taping of a wide range of textile structures. They are also experienced and equipped for large-scale connection testing with extreme local forces. Picanol and Vandewiele have large expertise in in-line measurement instrumentation of both mechanical components (rollers, reeds, ...) and textile components (warp tension, weft insertion, ...) during manufacturing (weaving, tufting, ...). They possess different sensors equipped for high-speed measurements as well as high-speed cameras for visual conformation of machine and textile behaviour under dynamic circumstances. Furthermore, they currently use internal textile modelling tools aimed at manufacturing simulations. Siemens Industry Software NV develops state-of-the-art commercial software based tools that aid in multi-physics performance metrics prediction, workflow automation and acceleration, and process optimization. UGent-CTSE is an important research group within fibre materials in Europe and has long-term expertise in fibre and fibre-based materials, with activities that lie in the field of the mechanics of textile materials and processes through experimental and numerical research. UGent-MMS is specialized in mechanical analysis and modelling of materials and has over 15 years of expertise on micromechanical and multi-scale modelling of composites and related materials. Both research groups contribute to the mechanical testing and simulations in the project.