Università degli Studi di Padova, Italy
PROFACTOR GmbH, Steyr-Gleink, Austria
IT+Robotics SRL, Italy
ESI Group S.A., France
Benteler SGL Composite Technology GmbH, Austria
Advance Composite Fibers SL, Spain
Institut National des Sciences Appliquees de Lyon, France

FIBREMAP -

Automatic Mapping of Fibre Orientation for Draping of Carbon Fibre Parts

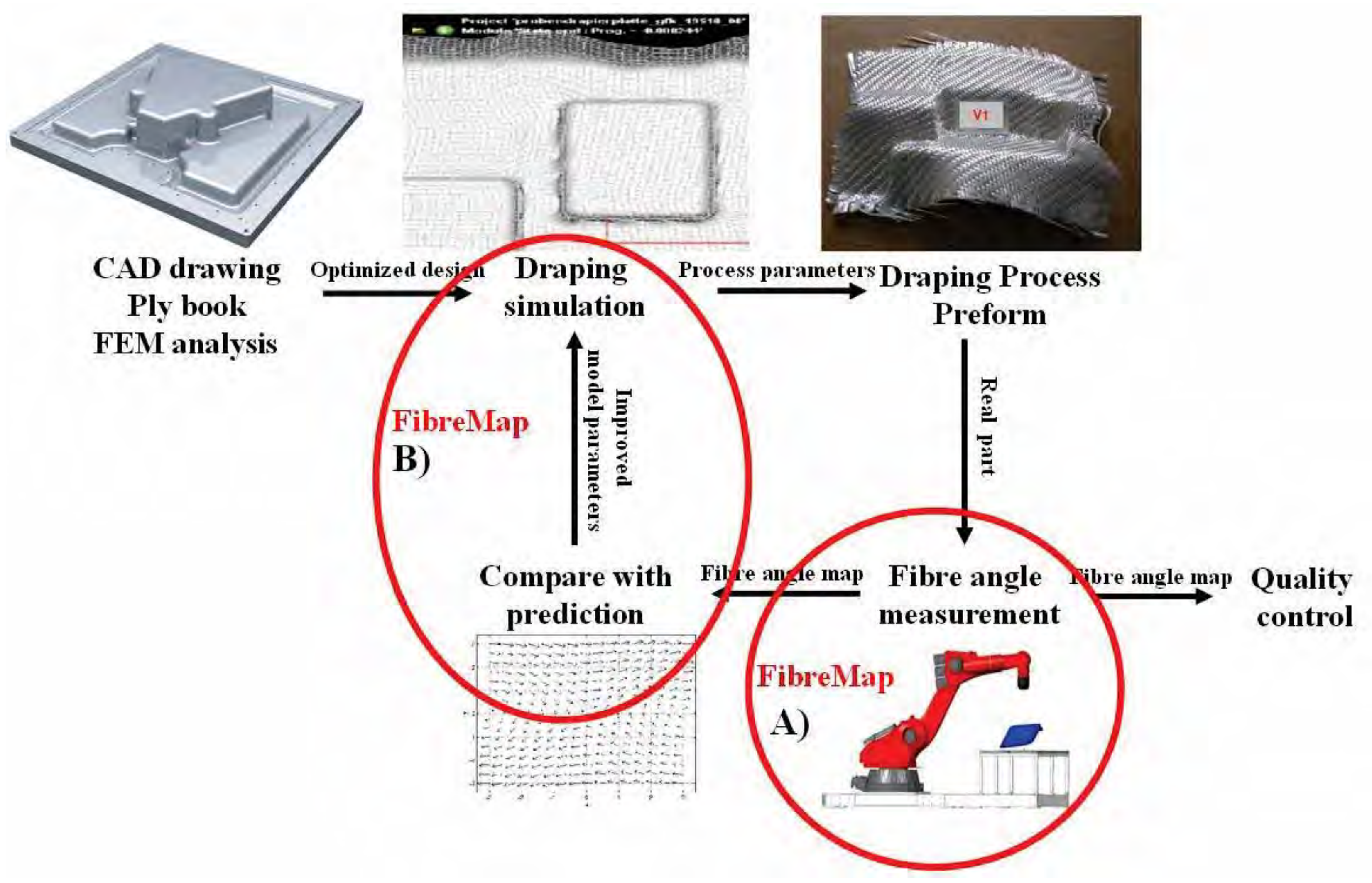
M. Munaro, M. Antonello, C. Eitzinger, E. Menegatti

Introduction

This project aims at the **development of a fully automatic system for measuring and mapping of fibre directions** on carbon fibre parts of complex shape and feeding these data back into simulation tools to optimize the production process. As an additional benefit, an integrated quality control system will result from the project.

There is a strong interest in the development due to a lack of technologies for accurate fibre angle measurement and prediction, which has several negative consequences: Carbon fibre structural parts are designed to be light and strong. However, safety factors need to be considered to compensate for the lack of detailed knowledge about the material, and the mechanical properties, but also for the currently unknown differences between the part “as designed” and “as produced”. This leads to unnecessarily high safety factors. Aside from being lightweight and strong, carbon fibre parts are often expected to have the typical carbon look, with the pattern of the carbon material still being visible. For these parts, it is also important to have the fibres aligned e.g. to the edges of the part, which currently can only be obtained through lengthy and time-consuming experimentation.

Aim of the Project



The FibreMap project aims at the development of two key technologies:

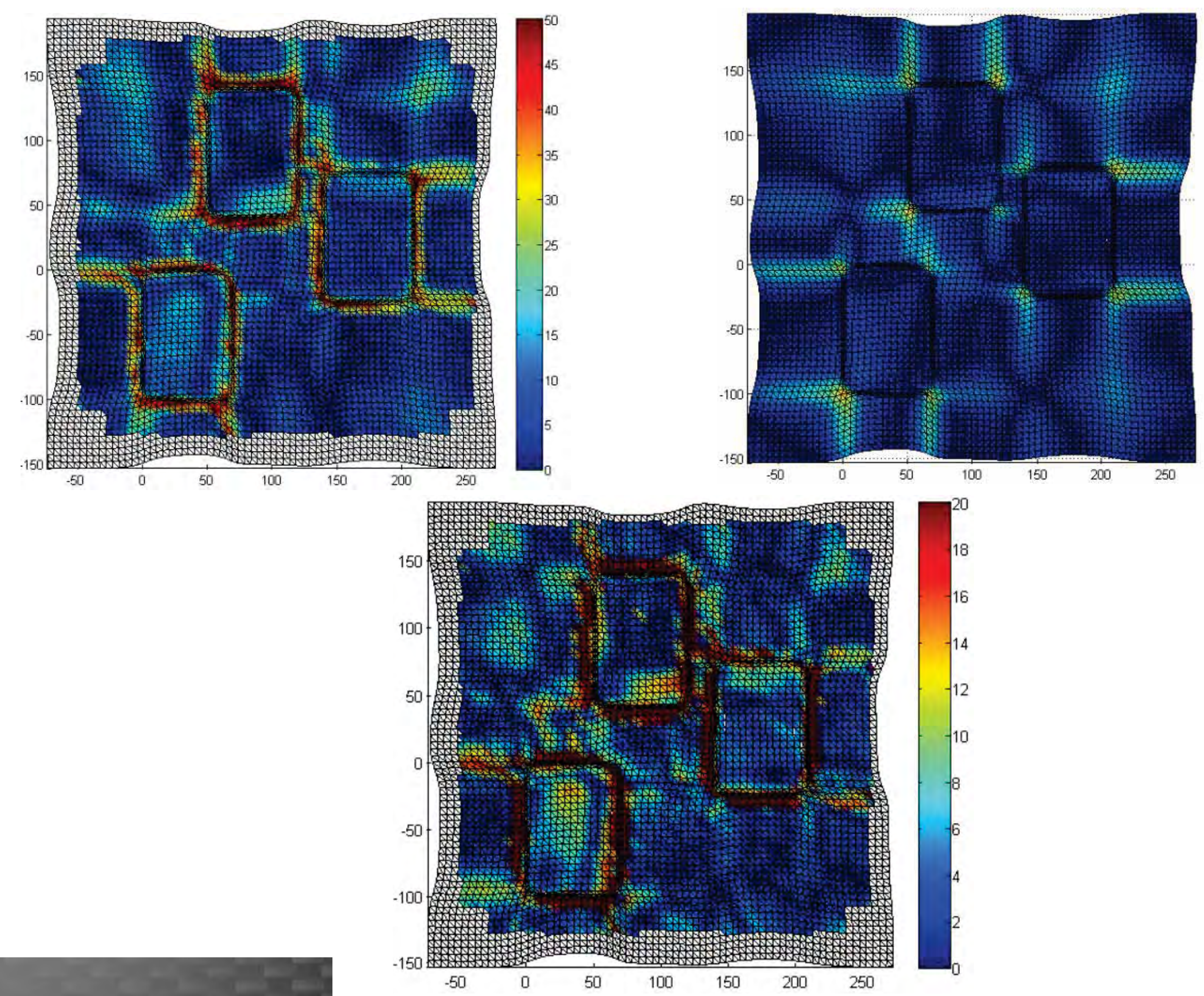
- (A) a **fibre angle measurement system** to acquire a dense mapping of fibre directions on carbon fibre parts of complex shape,
- (B) **computational methods** that use the data generated by the fibre angle measurement system **to improve draping simulatio**n so that it can more accurately predict fibre angles and adjust the production process accordingly.

Fibre Angle Measurement

Fibre Angle measurement uses a specific, patented sensor technology that is able to acquire a dense mapping of fibre angles from images acquired from a carbon fibre surface [1]. The accuracy of the sensor system could shown to be below 1° . This sensor is mounted on a robot that will scan the whole part by following an automatically generated path that covers all relevant surface areas on the part. Using accurate calibration and synchronisation mechanisms, the measured fibre angles can be projected on the 3D model of the part [3]. These 3D data will then provide the input for quality control and as measurement data to improve draping simulation.

Draping Simulation

From the CAD geometry of the tools and the material properties of the carbon fibre part the simulation of the “3-hills” preforms has been performed using PlasFib software. This internal INSA software uses a semi-discret approach, where the composite fabric is considered as a set of a discrete number of unit woven cells submitted to membrane loadings (i.e. biaxial tension and in-plane shear) and bending [2]. Fibre direction and shear angles obtained from the experimental optical measurements are compared to those obtained by draping simulations using a “comparison tool” developed for this purpose.



Intelligent Autonomous Systems Laboratory (IAS-Lab)
Dept. of Information Engineering
Via Gradenigo 6A
35131 – Padova (ITALY)

Prof. Emanuele Menegatti
Tel +39 049 8277651
emg@dei.unipd.it
http://robotics.dei.unipd.it/

PROFACTOR GmbH
Im Stadtgut A2
A-4407 Steyr-Gleink

Christian Eitzinger
Tel +43(0)7252/885-0
Fax +43(0)7252/885-101
christian.eitzinger@profactor.at
www.profactor.at

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