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The Dragon Tree as Model

Freiburg researchers receive Materialica Gold Award 2016 for three-legged fiber-reinforced ramifications

A team including Prof. Dr. **Thomas Speck** and Dr. **Tom Masselter** from the Plant Biomechanics Group and the Botanical Garden of the University of Freiburg received the Materialica Design + Technology Gold Award 2016 in the “surface and technology” category. The research groups were awarded for developing a technical fiber-reinforced ramification modeled on the basis of branch–stem-attachments of dragon trees. The study was conducted in cooperation with colleagues from the Reutlingen University, the Institute of Textile Technology and Process Engineering (ITV) Denkendorf, and the Dresden University of Technology (TU). The trade fair organizer MunichExpo Veranstaltungs GmbH awards the prize each year at the International Materialica trade fair to recognise outstanding product developments at the interface between material application and design.

The inspiration for the study was the shape and internal structure of dragon tree (*Dracaena marginata*) branches. The team focused especially on the order and the course of the very stable vascular bundles around the node at which the branches diverge from the trunk. This structure enables the side branches of the dragon tree to withstand high bending loads. The researchers used among other methods high-resolution magnetic resonance imaging to study the behaviour of the branches in a loaded and an unloaded state. This enabled observing for the first time how the plant tissue is displaced when subjected to a load. The images served as the basis for three-dimensional computer models, which the scientists used to develop a

method for manufacturing single- and multiple-branched technical fiber-reinforced structures.

For the meshwork and the braiding process, which was carried out at ITV Denkendorf and at the TU Dresden's Institute of Lightweight Engineering and Polymer Technology (ILK), the researchers laid special focus on achieving an optimal distribution of forces in the fibers at the branching point of the meshwork, as is the case in the natural model. In addition, they succeeded in integrating more fibers into the branches than are available in the main axis without having open fiber ends in the component. The advantage of this is a continuous main fibre path in which the component is not weakened by a reduced amount of fibers in the main path or by added fibers with open ends. The researchers appliedfor a patent for their method. Technical fiber-reinforced ramifications can be used in automotive and mechanical engineering, in aerospace engineering, as well as in architecture.

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