Tobias Haushahn

PhD-student, scientific staff

P: +49-761-203-2999

E: tobias.haushahn@biologie.uni-freiburg.de

PhD-Thesis

Branched natural fibrous composites for improved technical components

Project

Branched natural fibrous composites for improved technical components

Project description

The major goal of this project is the development of structurally optimized, branched fibrous compound structures for technical use as lightweight construction elements with a high load-bearing capacity inspired by hierarchically organized, branched plant structures. The biological role models for these elements are the ramifications of selected plant species with a pronounced fibre-matrix-structure (see section 2.1), optimised in the course of biological evolution under various kinds of static and dynamic loads. It could be shown in project phase 1 (see section 2.1) that stem-branch attachments in Dragon trees (Dracaena spp.) and different Freycinetia-species (both arborescent monocotyledons) and branched columnar cacti possess a high potential for transfer into technical adaptation. Further analysis of the hierarchical composition at the branching regions (structuring and multiscale mechanics of branching regions on various hierarchical levels, arrangement and orientation of fibre-/wood-bundles and fibres, internal structure of the wood fibres) and evaluation of the mechanical significance of the specific arrangement of fibre-/wood-bundles and fibres by means of modern state-of-the-art material testing and simulation techniques (section 3.2), will allow to adjust and modify the customised manufacturing processes developed in phase 1, and to further develop the already started manufacture of innovative fibrous compound structures inspired by biological models.

Funding

http://spp1420.mpikg.mpg.de/

Publications

Original papers

Müller, L., Milwich, M., Gruhl, A., Böhm, H., Gude, M., Haushahn, T., Masselter, T., Speck, T., Schwager, H. Neinhuis, C.: Biomimetisch optimierte verzweigte Faserverbundstrukturen mit hoher Tragfähigkeit. Melliand Textilberichte 2/2013, 88–93.

Haushahn, T, Schwager, H., Neinhuis, C., Speck, T. and Masselter, T.: Plant Ramifications inspire branched lightweight composites. Bioinspired, Biomimetic and Nanobiomaterials 2, 77-81 (2012).

Schwager, H., Haushahn, T., Neinhuis, C., Speck, T. and Masselter, T.: Principles of branching morphology and anatomy in arborescent monocotyledons and columnar cacti as concept generators for branched fibre-reinforced composites. Advanced Engineering Materials 12 (12), B695-B698 (2010).

Book chapters

Masselter T., Barthlott W., Bauer G., Bertling J., Cichy F., Ditsche-Kuru P., Gallenmüller F., Gude M., Haushahn T., Hermann M., Immink H., Knippers J., Lienhard J., Luchsinger R., Lunz K., Mattheck C., Milwich M., Mölders N., Neinhuis C., Nellesen A., Poppinga S., Rechberger M., Schleicher S., Schmitt C., Schwager H., Seidel R., Speck O., Stegmaier T., Tesari I., Thielen M. and Speck T.: Biologically inspired products. In: Bar-Cohen, Y. (ed.), Nature based Innovation, CRC Press, Pasadena (2011).

Masselter, T., Haushahn, H., Schwager, M., Milwich, M., Nathanson, R., Gude, M., Cichy, F., Hufenbach, W., Neinhuis, C. and Speck, T.: Biomimetic fibre-reinforced composites inspired by branched plant stems. In: Brebbia, C.A. (ed.), Design and Nature V, 411 – 420, WIT Press, Southampton, Boston (2010).

Conference proceedings

Haushahn, T., Fink, S., Masselter, T., Speck, T.: General biomechanics and functional morphology of *Dracaena marginata*. Proceedings of the 7th Plant Biomechanics Conference, Clermont-Ferrand, France 2012.

Masselter, T., Haushahn, T., Cichy, F., Gude, M. and Speck, T.: Ramifications in Plant Stems as Concept Generators for Branched Technical Fiber-Reinforced Composites. In: WCB 2010, IFMBE Proceedings 31, 36–39, Lim, C.T. & Goh, J.C.H. (Eds.), Springer, Heidelberg, Germany (2010).

Speck, T., Masselter, T., Speck, O., Haushahn, T., Neinhuis, C., Schwager, H., Milwich, M., Nathanson, R., Gude, M., Cichy, F. and Hufenbach, W.: Verzweigte Faserverbünde nach dem Vorbild der Natur. Proceedings of the Denkendorfer Symposium „Bionik und Faserbasierte Werkstoffe“: 21 S., Institut für Textil- und Verfahrenstechnik (ITV) Denkendorf, Germany (2010).

Conference talks

Haushahn, T., Fink, S., Masselter, T., and Speck, T.: General biomechanics and functional morphology of Dracaena marginata. 7th Plant Biomechanics Conference, Clermont-Ferrand, France (2012).

Haushahn, T., Schwager, H, Neinhuis, C., Speck, T., and Masselter, T.: Biomechanics and functional morphology of branched arborescent monocotyledons and columnar catci. Bioinspired Materials Conference, Potsdam (2012).

Haushahn, T., Speck, T.: Plants as concept generators for biomimetic fiber-reinforced composite materials. Biomimetic Fibre Composites Workshop, Bremen (2011).

Haushahn, T., Masselter, T. , Speck, T.: Biomechanics and functional morphology of the ramifications of arborescent monoctoyledons. Annual Meeting of the Society for Experimental Biology (SEB), Glasgow (2011).

Haushahn, T., Speck, T., Masselter, T., Milwich, M., Nathanson, R.: Plant ramifications as role models for branched biomimetic fibre-reinforced composites. MSE, Darmstadt (2010).

Haushahn, T., Speck, T. and Masselter, T.: Optimisation of technical fibre-reinforced composites by using branched plant stems as concept generators. Annual Meeting of the Society for Experimental Biology (SEB), Prague, (2010).