

**Management:**

Prof. Dr.-Ing. Veit Senner, Director

Administrative Staff:

Simona Chiritescu-Kretsch

Research Scientists:

Dr. rer. nat. Stefan Lehner (until 10/2014)

Dipl.-Sportwiss. Marius Janta, M.Sc.

Dipl.-Ing. Daniel Meyer

Dipl. Phys. Jürgen Mitternacht

Michaela Nusser, M.Sc. ETH (until 08/2014)

Publications 2013-14

- Bulut, J., Janta, M., Senner, V., & Kreuzer, J. (2013). Determination of Insulation Properties of Functional Clothing Using Core Body Temperature Gradients as Quantification Parameter. *Procedia Engineering*, 60(0), 208-213, from <http://www.sciencedirect.com/science/article/pii/S1877705813011089>.
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- Lehner, S., Binder, S., Mitternacht, J., & Senner, V. (2014). Entwicklung einer Testmethode der Ermüdungsbeständigkeit von Brustprothesen: Developing a Method for Testing the Fatigue Resistance of Breast Protheses. *Orthopädie Technik. Rehabilitation. Medizinprodukte*, 65. Jahrgang(11), 46-50.
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- Meyer, D., Steffan, M., & Senner, V. (2014). Impact of Electrical Assistance on Physiological Parameters During Cycling. *Procedia Engineering*, 72, 150-155.
- Mitternacht, J., Klement, A., & Lampe, R. (2013). Plantar pressure distribution during and after pregnancy. *European Orthopaedics and Traumatology*.
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Annual Report 2014

Jahresbericht 2014



Sport Equipment and Materials Group

R&D in sports technology combining engineering, sports science and computational methods



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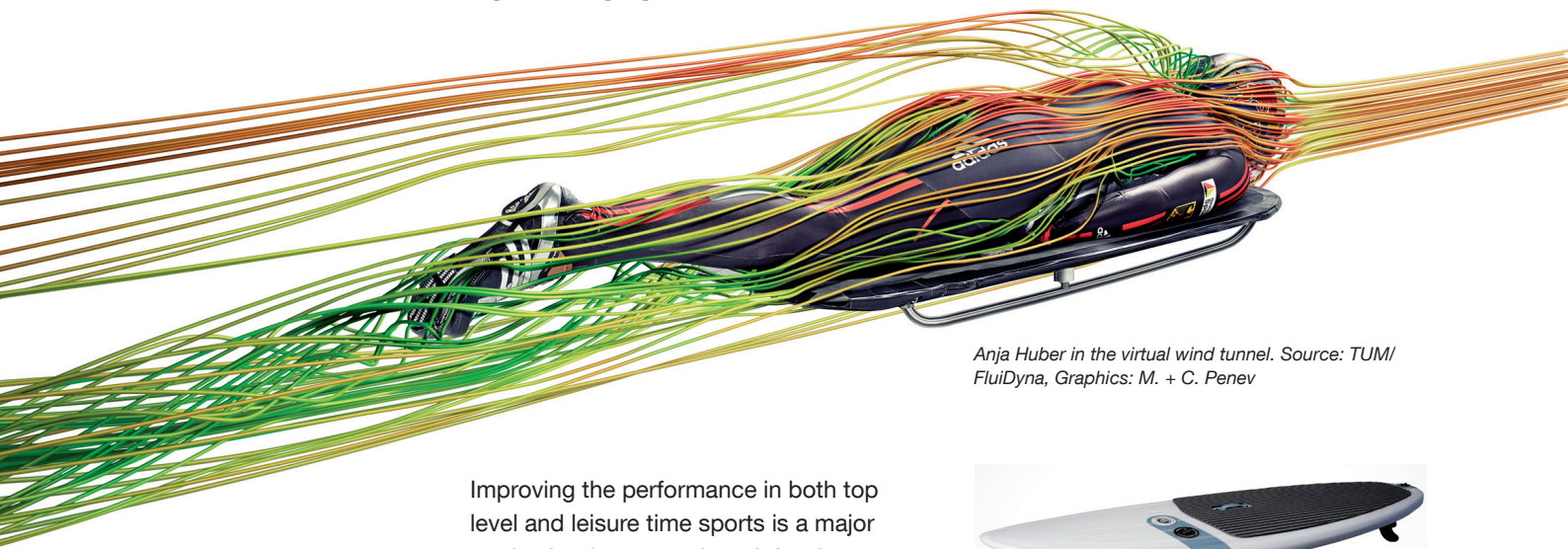
■ The focus of the sports engineering group in 2013-14 was to improve experimental expertise in knee biomechanics, to optimize our computer model of the human arm to simulate the preventive effect of wrist guards and to gain better insight on sports garment related thermo-physiology.

Three highlights are worth mentioning:

- launch of two start-ups within the frame of Federal Ministry for Economic Affairs' exist program.
- Optimization of Germany's top athlete Anja Huber's skeleton for the Olympic Wintergames in Sotschi

- TV report illustrating our research project 'mechatronic ski bindings' in Switzerland's major science broadcast 'Einstein'.

Towards Better Performance with Optimized Sport Equipment



Anja Huber in the virtual wind tunnel. Source: TUM/ FluidDyna, Graphics: M. + C. Penev

Improving the performance in both top level and leisure time sports is a major motivation for research and development of sports equipment. The focus is on energy transfer between athlete and equipment and can be optimized by

- improved fitting to the individual (i.e. golf shaft)
- better equipment weight to stiffness ratio (i.e. bicycle frame)
- energy return at optimal position of athlete's motion
- optimized heat- and moisture management (i.e. new infills for down jackets)

Industry and Public Funded Projects

- Optimization ergonomics of Olympic skeleton
- Development inflatable high-performance surfboard



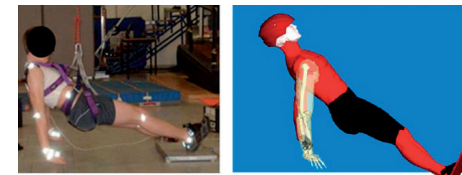
Patented surfboard of TUM start-up 'tripstix'. Graphics by TUM students S. Godoj and S. Hofelich

- Track and field sprint spike with synthetic leaf springs
- Impact sensation related to golf shaft's weight and flexibility



Skin- and core temperature measurements during garment test in climate chamber

Towards more Safety with Improved Protection Gear



Validation of arm-wrist-model to simulate snowboard backward falls

The avoidance of traumatic and also long-term sports injuries due to better protective equipment is one of the major challenges of our research.

Projects

- Development of a mechanical lower leg with instrumented knee and full muscle control
- Design of an emergency release system for winter sport equipment

Research Focus

- Improved performance of sport equipment
- Safety & protection gear to avoid overloads
- Thermo-physiology in sport garment design
- Footwear – sport surface interaction
- Electric & muscle-powered lightweight vehicles

Competence

- Muscular-skeletal models & simulation
- 3D-motion analysis (optical, inertia, DGPS)
- Electromyography (EMG) & spirometry
- Measurement of external loads & plantar pressure
- Development of physical models (foot & ankle, knee, lower leg)



EMG measurements and handling observation while climbing with a 'kids-friendly' carabiner

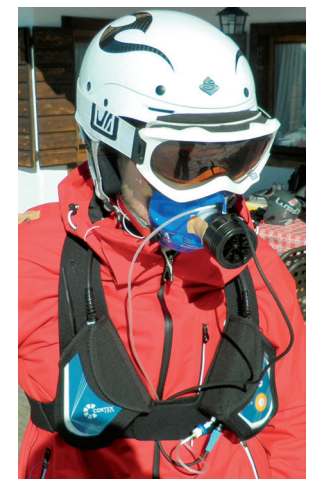
- Simulation of a worst case scenario of snowboard falls for evaluating the prevention effect of snowboard wrist guards
- Ergonomics of a climbing carabiner for children
- Determination of hip joint loads for different skiing manoeuvres

Infrastructure

- Mobile skin- and core-temperature measurement
- Multi-body simulation software SIMPACK®
- Mobile EMG and spirometry
- Video-based motion analysis SIMI®
- Knee surrogate with loading device
- Instrumented bicycle
- 5-axis fatigue testing device for bicycle frames

Courses

- Basic Skills of Science
- Applied Biomechanics
- Sports Technology
- Practical Ergonomics
- Digital Human Modeling
- Advanced Biomechanics
- Sports Engineering
- Interdisciplinary Research Project



Measurement of metabolic energy in skiing