French – German Summer School on **Evolutionary Solid Bodies**

**Growth and Remodelling of Biological Tissues**

**JugendGästehaus Aasee**
**Münster, Germany**

**September 8-14, 2013**

Summer School coordinated by

Jean-François Ganghoffer
INPL, Nancy, France

Franz-Joseph Barthold
TU Dortmund, Germany

Detailed information  
[www.esb2013.tu-dortmund.de](http://www.esb2013.tu-dortmund.de)

Supported by

Université franco-allemande
Deutsch-Französische Hochschule  
[www.dfh-ufa.org](http://www.dfh-ufa.org)

Ambassade de France à Berlin
Französische Botschaft in Berlin  
[www.ambafrance-de.org](http://www.ambafrance-de.org)

---

**Audience**

The Summer School is addressed to international PhD students and postdoctoral researchers in mechanical and civil engineering, applied mathematics, (bio)physics, biomedical engineering, physiology and material science who are interested in broadening their interests and knowledge in the area of growth and remodelling.

The Summer School is equally open to Master students, senior scientists and engineers from relevant industries.

**Location**

The Summer School will be held at the JugendGästehaus Aasee in Münster, Germany.

[www.djh-wl.de/jh/muenster](http://www.djh-wl.de/jh/muenster)

**Registration**

The registration fee of 250 € is to be paid by June 15, 2013 at the latest. It covers the participation of all lectures, a booklet of lecture notes, the social program, board (double rooms) and lodging (full board). Additional arrangements, request for travel grants and financial support as well as remarks on regular and late payment are posted at

[www.esb2013.tu-dortmund.de](http://www.esb2013.tu-dortmund.de)

Registration is open until May 15, 2013 to guarantee the desired accommodation.

**Organisation**

Jean-François Ganghoffer  
INPL – ENSEM – LEMTA, Nancy, France
Jean-Francois.Ganghoffer@ensem.inpl-nancy.fr

Franz-Joseph Barthold  
TU Dortmund, Germany  
Franz-Joseph.Barthold@tu-dortmund.de
Objectives
The Summer School shall address the issues of constitutive modelling of soft (such as arteries, ligaments and tendons) and hard biological tissues (typically bones) in stable and evolutive situations, covering growth and remodelling in relation to optimisation, which are hot topics in the mechanical community.

The scientific idea behind the Summer School is then to work out the common fundamentals in both theory and computation of the two core topics.

1. Structural optimisation
Here, the engineer is used to designing optimal structures by modifying any of the above mentioned entities. In detail, different scalar valued design variables of different kinds can be introduced for parameter, thickness, shape and topology optimisation. Thus, every quantity has so far been considered as design variable. The computational approaches solve the application problems on the discrete level while neglecting the fundamental problem of a fixed solid body. The advantages of structural optimisation lie in the fact that every discrete quantity has already been considered as design variable. The main drawback of structural optimisation is due to the less developed theory of variations of all quantities in a continuum mechanical framework. Modifications by the engineer can be interpreted as design evolutions but they have not been modelled as a time depending process.

2. Biological evolution
This scientific field entered the realm of continuum mechanics in the 1990’s. Time-dependent phenomena, basically consisting of a variation of material properties, mass and shape of the solid body, are attempted to be incorporated into the continuum description. One outstanding problem in developmental biology is the understanding of the factors that may promote the generation of biological form, involving the processes of growth (change of mass), remodelling (change of properties), and morphogenesis (shape changes). These three aspects of the development of a biological structure have tied mutual connections, and are due to a combination of chemical agents and mechanical factors, such as strains and stresses.

The challenge of linking both pillars
One main objective of the Summer School is then to (attempt to) unify the computational techniques known in structural optimisation (engineer has learned how to compute modifications of every quantity which, however, lie outside the physical time) and to combine them with rigorous mechanical models for open systems and modifications in material space. We shall then propose a classification of phenomena of biomechanics with respect to their a.) kinematical and b.) physical behaviour. This should be based on the classification mentioned above.

Important Dates
- Registration open until May 15, 2013
- One-page abstract until May 15, 2013
- Notice of acceptance until May 31, 2013
- Payment of fee until June 15, 2013
- Summer School September 8-14, 2013

www.esb2013.tu-dortmund.de

Structure of the Summer School
The Summer School will start on Sunday evening, September 8, 2013, with a reception and will finish on Saturday afternoon, September 14.

1. The Seminar
The lectures will concentrate on the fundamentals, on the linkages of both pillars as well as on selected advanced problems. Special emphasis will be given to discussions between speakers and participants.

2. The Workshop
The research field splits up in several branches and representative applications which can hardly be unified. The goal of the Workshop is to let PhD students and post-docs present specific problems related to the core topics. Participants intending to present a talk are asked to register and submit a title and one-page abstract before May 15, 2013.

3. The Tutorial
The comprehension of the theoretical contents presented in the seminar lectures will be increased by computing and programming tutorials devoted to the computational details.

Invited Speakers
- Franz-Joseph Barthold, Dortmund, Germany
- Anne Sophie Bonnet, Metz, France
- Emilie de Brosses, Metz, France
- Jean-François Ganghoffer, Nancy, France
- Cédric Laurent, Liège, Belgium
- Daniel Materna, Ioannina, Greece
- Andreas Menzel, Dortmund, Germany
- Jörn Mosler, Dortmund, Germany
- Tim Ricken, Dortmund, Germany
- Jan Sokolowski, Nancy, France
- Xiong Wang, Nancy, France

See www.esb2013.tu-dortmund.de for details.