CITY OF FREUDENSTADT

SCHWARZWALD

KARLSRUHE INSTITUTE OF TECHNOLOGY

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INTENSIVE PROGRAM

ANALYTICAL AND COMPUTER ASSISTED METHODS IN MATHEMATICAL MODELS

ACAMIMM

FREUDENSTADT

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Coordinated by Kazimierz Wielki University
Institute of Mathematics
Bydgoszcz Poland

Hosted by Karlsruhe Institute of Technology

Institute for Analysis
Karlsruhe Germany

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What is ACAMIMM?

Computer methods are successfully used by scientists in mathematics. However, the latest results and newest methods are often available only among specialists. Thus, there is a need to make these modern methods available to larger groups of young students and future scientists. On the other hand it has been proved that the mentioned theory is partially applicable in physics and high level mechanical and automation engineering.

We propose a combination of four main modules in order to create a new course:

1. **photonic crystals including Maxwell equations and photonic band gaps;**
2. **calculus of variations, application to elasticity and optimization;**
3. **functional equation and inequalities;**
4. **generalized convexity.**

Who is ACAMIMM for?

The course is designed for MSc and PhD students in Mathematics, Computer science and Physics. Outstanding Bachelor students are welcomed to attend the course, too.

What are its main goals?

Thanks to the intensive program students will understand the basics principles of photonic crystals and their mathematical modeling. They will experience the numerical tools for computing and for rigorous verifying photonic band gaps. Furthermore they will learn in detail about many different notions of convexity. They will understand how different notions of convexity are important in nonlinear elasticity to describe the deformation of elastic materials using the language of the calculus of variations. At the same time they will realize that similar notions of convexity are the key to solving problems in finite dimensional optimization theory. Finally, next to numerical approximation methods, students will also be able to use different computer assisted methods, namely computer algebra systems, to solve functional equations and inequalities.

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What are the advantages?

We will work in an international group of students and teachers from Poland, Romania, Germany and Hungary.

The course will take place in Freudenstadt – a picturesque town in Schwarzwald. We spend a weekend travelling to Strasbourg and we plan to visit the European Parliament.

During the course students will collect **6 ECTS** credits. The exact amount of credits depends on a number of tests passed by a particular student. Preparatory e-learning activities are included into the number of credits to be obtained. Participants will be provided with a confirmation of participation and transcript of records. Full recognition is guaranteed at each partner university. ECTS credits and grades achieved during the summer course will be recognized as an equivalent standard course at the home university.

The main goal of the project is to present some of the newest research results. One of the project advantages is that the theory will be presented directly by its authors. Students will approach a new theory by attending lectures and tutorials, where problems are discussed and computer experiments are carried out. Students will also learn how to write a computer application in computer algebra system in order to solve functional equations and inequalities. Similarly, students will gain experience in using programming languages for the numerical solution of Maxwell's equations and in using programming tools for establishing rigorous enclosures in the area of computer-assisted proofs.

Students' results achieved with use of ICT tools will be presented at the end of the course to the whole group. Students will take tests at the end of each module of the course.