Applied and Computational Mathematics

Graduate Program 2020-21

University of Crete
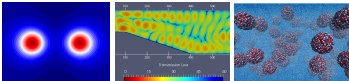
June 4, 2020

The Program

The program (started on 2018) offers the following streams

- Scientific Computing
- Modeling and Analysis in Sciences and Technology
- Statistics and Stochastic Analysis

There are currently 20 graduate students pursuing the MS degree, and 10 PhD candidates.

Website: http://www.math.uoc.gr/gpacm/

Courses offered

The graduate program offers courses in

- Applied Functional Analysis
- Methods in Applied Mathematics
- Modeling in the Sciences and Technology
- Mathematical Theory of Solids
- Multi-scale Simulations and Statistical Mechanics
- Numerical Analysis
- Numerical Solution of Differential Equations
- Stochastic Processes
- Statistical Inference and Machine Learning
- . . .

Students may also enroll on courses in Computer science, Physics, Pure mathematics, etc.

Project work and Seminars

- 1st year courses include project work, rather than only lecturing and exercise.
- 2nd year is mostly devoted to thesis work. Students may also attend more courses, e.g., reading courses.
- Master thesis can be carried out also in research institutions (e.g. FORTH) and companies in Europe.

- Short term seminar series (one or more weeks) are given by local and visiting staff (Erasmus courses), depending on availability.

Scholarships and Fellowships

There are no tuition fees.

Funding possibilities:

- Fellowship "M. Manasaki" from the University of Crete

- Fellowship "S. Pichoridis" from the Institute of Applied and Computational Mathematics at FORTH

- Scholarships via research projects at the University or at the FORTH research center.

Faculty research directions

The staff associated with the ACM graduate program conduct research in many areas, including

- Modeling in Sciences and Technology
- Numerical Solution of Differential Equations
- Applied Differential Equations
- Stochastic Processes and Applied Statistics

The graduate program is in close collaboration with the Institute of Applied and Computational Mathematics at Foundation of Research and Technology - Hellas (IACM/FORTH).
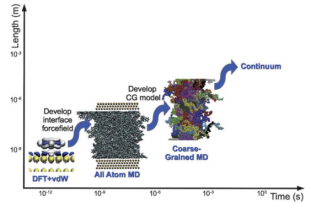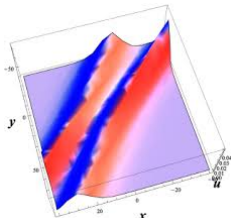
Outward looking

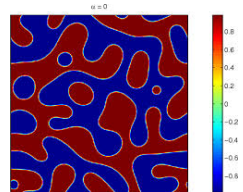### Magnetic recording
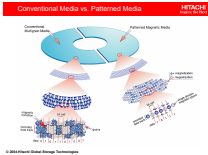
Complex systems

Applied and Computational Mathematics

Waves in optics

Phase separation
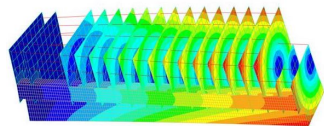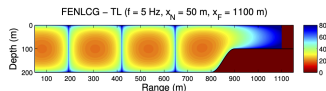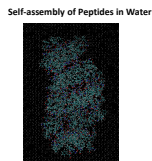
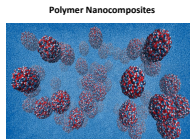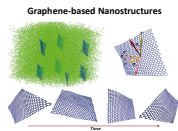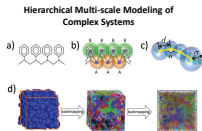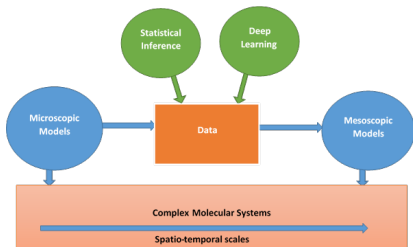# Numerical Analysis

- Numerical methods for deterministic and stochastic differential equations
- Adaptive algorithms for computational fluid dynamics, conservation laws, wave propagation
- Evolution equations, adaptive algorithms for nonlinear PDE's and for models across scales
- Finite element and volume methods

FENLCG – TL (f = 5 Hz, x_N = 50 m, x_F = 1100 m)
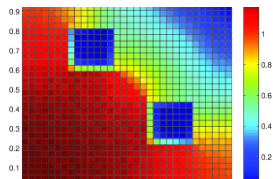
Molecular Modeling and AI Technologies

- Multi-scale methodologies and simulations for molecular systems
- High performance computing (HPC) and Deep learning methods
- Data-driven statistical inference methods for predicting structure-properties relations
- "In silico" (virtual design) of advanced materials

Hierarchical Multi-scale Modeling of Complex Systems

Graphene-based Nanostructures

Polymer Nanocomposites

Self-assembly of Peptides in Water

Mathematical Modeling of photoVoltaic(PV) systems

- Model the operation and power output of PV systems
- Mathematical model depending on the solar cell architecture
- System of nonlinear PDE's
- Numerical solution of the mathematical model
- Simulations vs experiments $\longrightarrow$
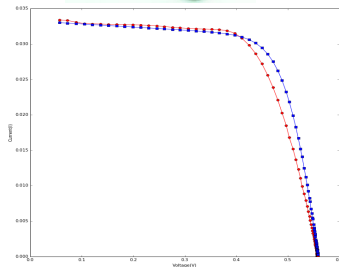- Use Machine Learning to estimate unknown operational parameters of solar cell

Figure: Red: Experiment, Blue: Simulation

Mathematical Modeling of surface water waves

- Propagation of water surface wave
- Basic principles: conservation of mass and momentum
- Numerical solution of the mathematical model
- Simulations: solitary wave propagation and interaction with objects
- Generation, Propagation of Tsunamis
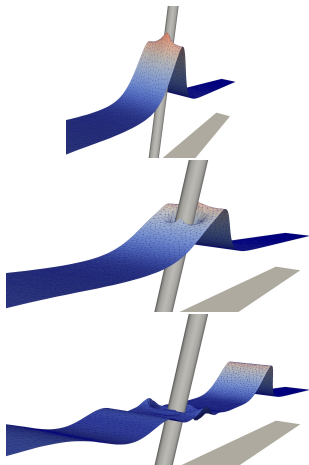
Solitons in condensed matter

- Nonlinear partial differential equations often govern the microstructure in materials.
- Construct or modify a model.
- Connect to topology, PDEs, etc.
- Solutions (solitons) and properties (conservation laws).
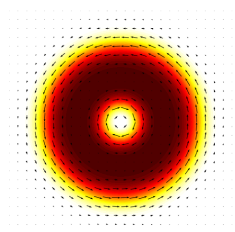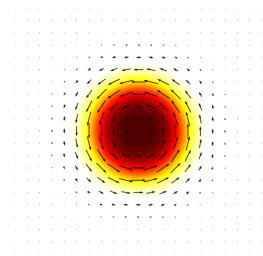
Dynamics of microstructure (animation)

Prospects

Research work towards a PhD degree in Greece or in other countries (Germany, U.K., etc.)

- on Mathematics
- on Sciences or Engineering

Work in industry, SMEs on

- scientific computing, HPC
- data analytics
- consulting
- software development
- . . .