## Department of Mathematics and Computational Sciences

### Faculty of Engineering Sciences

<table>
<thead>
<tr>
<th>Department of Mathematics and Computational Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head of department:</strong> Dr. Zoltán Horváth</td>
</tr>
<tr>
<td><strong>Position:</strong> College professor</td>
</tr>
<tr>
<td><strong>Contact information:</strong></td>
</tr>
<tr>
<td><strong>Telephone:</strong> +36 96 503 647</td>
</tr>
<tr>
<td><strong>E-mail:</strong> <a href="mailto:horvathz@sze.hu">horvathz@sze.hu</a></td>
</tr>
<tr>
<td><strong>Homepage:</strong> <a href="http://math.sze.hu">http://math.sze.hu</a></td>
</tr>
</tbody>
</table>

### Research profile:

- Mathematical modelling; setting up industrial, mathematical models
- Development and application of the numeric methods for solving engineering problems
- Numerical solutions and qualitative analysis of differential equations
- Finite element methods (FEM)
- Development of finite volume methods, flow calculation methods (CFD)
- Industrial application of FEM and CFD methods
- Meshfree methods
- Margin-integral equation methods
- Interpolation techniques
- Equations, computational numerical modelling of continuum-mechanics
- Parallel numeric algorithms
- Mathematical bases of operations research
- Non-linear and global optimization
- Automated optimization for complex simulations
- Mathematical methods of decision preparation
- Data mining, collaborative filtering
- Logical game programming
- Optimization of production scheduling
- Computer algebra, fractal geometry
**Applied Methods / Special tools:**

- Theoretical and applied methods of mathematics and computational sciences, with special regard to performing computational simulations and utilization of their results

- Special software: Hypermesh, Abaqus, MD Nastran, Fluent, Matlab, Maple, GAMS

- Special hardware: GPU and FPGA workstations; HP BL260C blade server (12 compute node, each having 2 pieces of 3GHz Quad-Core Intel Xeon, 16GB RAM, infiniband interconnect)

- Use of FEM programme packages: HyperMesh, Abaqus, MD Nastran

- Use of CFD programme packages: ANSYS Fluent

- Use of general purpose mathematical software: MS Excel, Matlab, Maple

- Preparing own code on C, C++ programming languages

- Programming of multiprocessor, staging memory computer with MPI system

- Programming of hardware accelerators: GPU (with C for CUDA) and FPGA (with Impulse C)

- GAMS modelling and optimizing software

- Computational programme packages, serving the solution of mathematical optimization models: GAMS, MS Excel, WinQSB

- Use of statistical programme packages: SPSS, Clementine

- Information technology in the education

- Electronic teaching material preparation and recitation

**Services:**

- Solution of practical problems with the help of optimizing software

- Model calculations, studies, analyses, preparing recommendations

- Industrial mathematical calculations: finite element and flow calculations

- Data mining, recommendatory systems, risk analysis

- Performing high-performance calculations (HPC), code production, and/or hiring materials

**References:**
1. Simulation and optimization

*Type:* TÁMOP 4.2.2

*Aim:* To perform basic research for the development of simulations, based on quick, modern hardware for complex physical and production systems

*Tasks, performed by the Department:* Developing of parallel programming methodologies and preparing simulations - based on the methodologies - with its own codes, mathematical modelling of physical processes, and numeric analysis of mathematical models

*Duration:* 2009-2011

*Project partners:* Lehigh University (Betlehem, PA), Eötvös Lóránd University of Sciences, HTEC (company, USA), University of Graz, Johannes-Kepler-University Linz, King Abdullah University of Science and Technology (KAUST)

2. Development of digital holographic interferometry with increased optic angle and resolution and its application in shape- and deformation measurement

*Type:* GVOP-3.1.1.,-2004-05-0403/3.0

*Aim:* To develop numeric algorithms and software for digital holography

*Duration:* 2005-2007

*Project partners:* Budapest University of Technology and Economics - Department of Physics

3. EAP research

*Type:* INNOREG (ND_INRG5_07ENTALSZE)

*Aim:* To state equations of state of EAP materials, to establish a mathematical model, to define the behaviour occurring as a result of an electrical field. To develop algorithms - suitable for the calculation of deformations - for simulations

*Duration:* 2008-2010

*Project partners:* ENTAL Ltd.
1. Vehicle Industrial Regional University Knowledge-centre

Type: Industrial commission

Aim: To perform research connected to the vehicle industry

Tasks, performed by the Department: Performing computational simulation of the flow around the motor vehicle, then calculating the noise of the external mirror; optimizing the suction- and exhaust system of the diesel-engine; studying the heating of the valve seat; determining the tolerance accuracy of the external mirror, based on the CAD-model

Duration: 2006-

Principals: SAPU limited partnership, Deutz AG., Audi Hungaria Motor Ltd.

2. Integrated Automotive Product and Technology Development Research

Type: Industrial commission

Aim: To perform research connected to vehicle industry

Tasks, performed by the Department: Calculating the heating of wet brakes, performing deflection-examinations on extreme load front running-gears

Duration: 2008

Client: Rába Vehicle Industrial Holding Inc.

3. OTP-project

Type: Bank commission

Aim: To perform a risk analysis

Tasks, performed by the Department: Developing the credit rating process for large data sets, including developing its own code

Duration: 2009

Client: OTP Bank, Budapest

4. Audi-project

Type: Industrial commission
Aim: To prepare software, to make a production plan based on orderings

Tasks, performed by the Department: Modelling, preparing software

Duration: March 2008 - October 2008

Client: Audi Hungaria Motor Ltd.

Keywords: mathematical modelling, numeric methods, differential equations, finite element methods, finite volume methods, flow calculations, methods, without web, automated optimization