

# Ferenc HEGEDŰS, PhD

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## Curriculum vitae



Name: Dr. Ferenc Hegedűs  
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## Education and Scientific Career

2018-present Budapest University of Technology and Economics,  
Department of Hydrodynamic Systems,  
**associate professor**

2013-2018 Budapest University of Technology and Economics,  
Department of Hydrodynamic Systems  
**assistant professor**

2012-2013 Budapest University of Technology and Economics,  
Department of Hydrodynamic Systems  
**assistant lecturer**

2007-2012 Budapest University of Technology and Economics,  
Department of Hydrodynamic Systems  
**PhD student**

2006-2007 Budapest University of Technology and Economics,  
Department of Hydrodynamic Systems  
**research fellow**

2001-2006 Budapest University of Technology and Economics,  
Faculty of Mechanical Engineering  
**M.Sc. in Mechanical Engineering**

## Major International Cooperation

2019 **9 months research visit (Humboldt research fellow):**  
Georg-August-Universität Göttingen, Third Institute of Physics,  
Göttingen, Germany; *Towards the optimisation of sonochemical  
reactors via the investigation of dual-frequency driven bubble clusters.*

2016 **2.5 months research visit:**  
Georg-August-Universität Göttingen, Third Institute of Physics,  
Göttingen, Germany; *Numerical investigation of dual-frequency  
driven cavitation bubbles and bubble fields in sonochemistry using  
massively parallel GPU programming.*

- 2013            **2 months research visit:**  
Hochschule Emden/Leer, Institut für Lasertechnik Ostfriesland, Emden, Germany; *Collapse of a laser induced cavitation bubble near the open surface of water.*
- 2011            **2 months research visit:**  
Hochschule Emden/Leer, Emden, Institut für Lasertechnik Ostfriesland, Germany; *Radial oscillation of a laser induced gas bubble in glycerine.*

### **Main Scientific Awards**

- 2022            **NRDI Fund for Young Researchers (4 years)**  
Acoustic cavitation and chemical kinetics: the role of GPU programming and machine learning in the scale-up of sonochemical reactors.  
*National Research, Development and Innovation Office*
- 2022            **NVIDIA Academic Hardware Grant Program**  
Introduction to High-Performance Computing for Engineers.  
Grant: 2 RTX A5000 24GB.  
*NVIDIA Corporation*
- 2021            **Bolyai+ Fellowship for Higher Education Young Teacher, Research (1 years)**  
Acoustic cavitation and reaction kinetics.  
*National Research, Development and Innovation Office*
- 2020            **Bolyai+ Fellowship for Higher Education Young Teacher, Research (1 years)**  
Acceleration of chemical processes by acoustic cavitation.  
*National Research, Development and Innovation Office*
- 2019            **János Bolyai Research Scholarship (3 years)**  
High-performance computing in acoustic cavitation: towards the optimisation of sonochemical applications via GPU clusters and machine learning.  
*Hungarian Academy of Sciences*
- 2019            **Bolyai Bolyai Emlékklap**  
Outstanding certification for the previous Bolyai scholarship.  
*Hungarian Academy of Sciences*
- 2019            **Humboldt Research Fellowship for Experienced Researchers (9 months)**  
Towards the optimisation of sonochemical reactors via the investigation of dual-frequency driven bubble clusters.  
*Alexander von Humboldt Foundation*
- 2018            **KNORR-BREMSE, BME Scholarship Program (5 months)**  
Program code development to aid the design of pneumatic control systems.  
*Knorr-Bremse Rail Systems Budapest Ltd.*
- 2017            **KNORR-BREMSE, BME Scholarship Program (10 months)**  
GPU accelerated numerical simulations to aid the design of pneumatic control systems.  
*Knorr-Bremse Rail Systems Budapest Ltd.*

- 2016 **Proposals for Grants to Support the Initiation of International Collaboration (guest researcher, 2.5 months)**  
 Numerical investigation of dual-frequency driven cavitation bubbles and bubble fields in sonochemistry using massive parallel GPU programming.  
*Deutsche Forschungsgemeinschaft (DFG)*
- 2015-2018 **János Bolyai Research Scholarship (3 years)**  
 Dynamic investigation of shock waves generated by ultrasound.  
*Hungarian Academy of Sciences*

### **Institutional Responsibilities**

- 2021-present **PhD Student Advisor**  
 Faculty of Mechanical Engineering, Department of Hydrodynamic Systems, Budapest University of Technology and Economics, Hungary.
- 2020-present **Member of the Committee of the Géza Pattantyús-Ábrahám Doctoral School of Mechanical Engineering**  
 Faculty of Mechanical Engineering, Department of Hydrodynamic Systems, Budapest University of Technology and Economics, Hungary.
- 2013-present **Secretary of the Scientific Student Competition**  
 Faculty of Mechanical Engineering, Department of Hydrodynamic Systems, Budapest University of Technology and Economics, Hungary.

### **Membership of Scientific Societies**

- 2021-2023 **Member of the Committee of the Hungarian Academy of Science, Hungary**
- 2013-present **Member of the Public body of the Hungarian Academy of Sciences, Hungary**

### **Leader of Recent Industrial Projects**

- 2018 **Gamma Analcont Ltd.**  
 Investigation of the degradation of microorganisms by hydrodynamic cavitation using natural water.
- 2018 **Gamma Analcont Ltd.**  
 Degradation of di-isobutyl-phthalate pollutant using hydrodynamic cavitation.
- 2017 **Momentous R&D Consulting Ltd.**  
 Preparation of expert report on the fundamental physics of acoustic and hydrodynamic cavitation and their effect on the degradation of hazardous chemical species and microorganisms.

### **Languages**

Hungarian	<b>Native</b>	<i>Mother tongue</i>
English	<b>Fluent</b>	
German	<b>Basic</b>	

## **Skills**

Programming expertise	C++, CUDA C, Matlab
Known software	AUTO bifurcation analysis software
Scientific proficiency	Massively parallel GPU programming Nonlinear dynamics Sonochemistry and acoustic cavitation Numerical methods Transport phenomena and gas dynamics

## **List of 10 key publications**

- Nagy D., Plavec L. and Hegedűs F. (2022) The art of solving a large number of non-stiff, low-dimensional ordinary differential equation systems on GPUs and CPUs. *Communications in Nonlinear Science and Numerical Simulation* **112**, p. 106521.
- Kalmár C., Turányi T., Zsély I. G., Papp M. and Hegedűs F. (2022) The importance of chemical mechanisms in sonochemical modelling. *Ultrasonics Sonochemistry* **83**, p. 105925.
- Hegedűs F. (2021) Program package MPGOS: challenges and solutions during the integration of a large number of independent ODE systems using GPUs. *Communications in Nonlinear Science and Numerical Simulation* **97**, p. 105732.
- Hegedűs F., Klapcsik K., Lauterborn W., Parlitz U. and Mettin R. (2020) GPU accelerated study of a dual-frequency driven single bubble in a 6-dimensional parameter space: the active cavitation threshold. *Ultrasonics Sonochemistry* **67**, p. 105067.
- Kalmár C., Klapcsik K. and Hegedűs F. (2020) Relationship between the radial dynamics and the chemical production of a harmonically driven spherical bubble. *Ultrasonics Sonochemistry* **64**, p. 104989.
- Varga R., Klapcsik K. and Hegedűs F. (2020) Route to shrimps: Dissipation driven formation of shrimp-shaped domains. *Chaos Solitons & Fractals* **130**, p. 109424.
- Klapcsik K. and Hegedűs F. (2019) Study of non-spherical bubble oscillations under acoustic irradiation in viscous liquid. *Ultrasonics Sonochemistry* **54**, p. 256-273.
- Hegedűs F. and Kalmár C. (2018) Dynamic stabilization of an asymmetric nonlinear bubble oscillator. *Nonlinear Dynamics* **94**(1), pp. 307-324.
- Hegedűs F., Lauterborn W., Parlitz U. and Mettin R. (2018) Non-feedback technique to directly control multistability in nonlinear oscillators by dual-frequency driving: GPU accelerated topological analysis of a bubble in water. *Nonlinear Dynamics* **94**(1), p. 273-293.
- Hegedűs F. (2016) Topological analysis of the periodic structures in a harmonically driven bubble oscillator near Blake's critical threshold: Infinite sequence of two-sided Farey ordering trees. *Physics Letters A*, **380**(9-10), pp. 1012-1022.