

Hadi Bordbar

Rakentajanaukio 4 A, FI-00076 Aalto University, Espoo, Finland

Tel: +358 (0) 400 38 7607 Email: hadi.bordbar@aalto.fi

PERSONAL PROFILE

Committed to ongoing research of sustainable energy systems

Qualified teacher and leader of research activity

Continuing interest in the numerical modeling of heat and mass transfer in energy systems

Special interest on modeling of radiation heat transfer in energy conversion processes
and multiphase flow modeling

Innovative and effective administrator

EDUCATION

2004-2005 Laboratory of computational fluid and bio fluid dynamics,
Lappeenranta University of Technology, Finland.
Doctor of Science (Tech.) in Energy Engineering with major focus on Heat
and Mass Transfer.

Thesis title: [Theoretical Analysis and Simulation of Vertically Vibrated Granular Materials](#), Lappeenranta University of Technology.

- Development of an analytical model for binary collision of multi size spherical particles.
- Finite element analyze of collision between different size granular particles.
- Development of a set of continuum equations for numerical modeling of dense granular material with Eulerian-Eulerian approach and applying the model to a vertically vibrated granular bed.
- Development of a discrete element model to analyze the fluid dynamics in a dense granular bed subjected to vertical vibration.

Examiners: Professor Kambiz Vafai (University of California-Riverside),
Professor Goodarz Ahmadi (Clarkson University).

Grade: Passed with honor

1999-2001 **Master of Science (Eng.)** in Mechanical Engineering, Energy Conversion.
Thesis title: Three dimensional modeling of a boiler furnace with radiative zone method.

- Development of an empirical model for fluid flow in the furnace of a pc boiler.
- Solving radiative heat transfer by zone method.

1994-1999 Bachelor of Science (Eng.) in Mechanical Engineering, Thermal and Fluid Engineering.

Thesis title: Design and construction of Saybolt viscometer with indirect heating system based on ASTM standard.

- Design and construction of a Saybolt viscometer for industrial oils.
- Design and construction of indirect heating system to make the desired thermal conditions.
- Studying the thermal behavior of several industrial oils.

EMPLOYMENT

Feb. 2018- **Fire Safety Engineering Research Group, Aalto University, Finland.**
Staff Scientist
 Proposing, managing, and conducting research projects, Teaching, Supervising the post-graduate students.

Jan. 2014-Jan. 2018 **Laboratory of Heat Transfer and Fluid Dynamics, Lappeenranta University of Technology, Finland.**
Associate Professor (Tutkija-Opettaja in Finnish)
 Proposing, managing, and conducting research projects, Teaching, Supervising the post-graduate students.

Sep. 2016- Sep. 2021 **School of Energy Systems, Lappeenranta University of Technology, Finland.**
Adjunct Professor (Docentship)
 Adjunct Professor (Docent), in radiative heat transfer in energy conversion processes.

May 2015 **University of Sheffield, UK.**
Visiting Lecturer/Researcher
 Visiting the Energy 2050 research team, research group of Professor M. Pourkashanian and the UK national center of [pilot-scale advanced capture technology \(PACT\)](#).

Jan. 2014- June 2014 **University of California-Merced.**
Visiting Professor
 Visiting the frontier radiative heat transfer research group of Professor Modest.

Jan. 2009-Dec. 2013 **Laboratory of Modelling of Energy Systems, Lappeenranta University of Technology, Finland.**
Senior Researcher
 Proposing, managing, and conducting research projects, Teaching, Supervising the post-graduate students.

- Jan. 2006-Dec.2008** **Lappeenranta University of Technology, Finland.**
Postdoctoral Researcher
Research and Teaching.
- Oct. 2004-Dec.2005** **Lappeenranta University of Technology, Finland.**
PhD Candidate
Research. The quickest doctoral study in the history of university with five supporting articles and the highest grade of “passed with honor.
- Feb. 2002-Sep.2004** **Yasuj University.**
Lecturer/Faculty Member
Teaching and research. I taught most of graduate courses of thermal and fluid engineering including heat and mass transfer, fluid mechanics, thermodynamics, engineering mathematics, numerical analysis, etc.

PROFESSIONAL MEMBERSHIPS

- Member of the editorial board of “[American Journal of Fluid Dynamics](#)” since Oct. 11th 2011.
- Member of advisory board/conference chair of Planetary Scientific Research Centre (PSRC) since Aug. 23rd 2011.
- Chair of the modeling session of the 22nd International Conference of Fluidized Bed Combustion (FBC22), Turku, Finland, June 2015.
- Chair of the interdisciplinary fields session in the 7th International Conference on Heat Transfer, Fluid Mechanics and Thermodynamics (HEFAT 2010), Antalya, Turkey, July 2007.
- Referee of *Energy*. (IF =4.159), *Applied Thermal Engineering* (IF =4.026), *J. of Quantitative Spectroscopy and Radiative Transfer* (IF =2.955), *Int. J. of Heat and Mass transfer* (IF =3.891), and *Int. J. for Numerical Methods in Fluids* (IF =1.060), *Fire Safety J.* (1.165).

SKILLS

- Programming languages such as C, C++, FORTRAN, etc.
- Engineering software and open source codes such as ANSYS-FLUENT, ICEM, Gambit, Matlab, OpenFOAM, MFX, Autocad, Mathematica, Tecplot, Feildview, Paraview, etc.
- General and Managing Software such as MS Office, Adobe Photoshop, etc.

PERSONAL HOBBIES

- Sport; fitness, running, basketball.
- Photography, reading, movies.

REFEREES

Professor Michael Modest

Science & Engineering Building I
Office 392,
5200 N. Lake Road
Merced, CA 95343,
USA

University of California-Merced, USA

mmodest@ucmerced.edu +1 209-228-4113

I visited the research group of professor Modest in 2014. He is well known scientist leading the research of radiation heat transfer.

Professor Goodarz Ahmadi

102 CAMP
Clarkson University
PO Box 5725
Potsdam, NY 13699-5725,
USA

Clarkson University, USA

ahmadi@clarkson.edu +1 315-268-2322

He was the reviewer and examiner of my doctoral thesis. He has published many high cited articles in the field of multiphase flow and turbulence.

Professor Simo Hostikka

Rakentajanaukio 4,
02150 Espoo,
Finland

Aalto University, Finland

simo.hostikka@aalto.fi +358 50 447 1582

He has been my colleague and supervisor in Aalto University since 2018.

Professor Timo Hyppänen

LUT School of Energy Systems,
Lappeenranta University of
Technology, P.O. Box 20,
53851 Lappeenranta,
Finland

Lappeenranta University of Technology, Finland.

Timo.Hyppanen@lut.fi +358 40-580-3180

He has been my direct supervisor since 11 years ago. We have done many research projects and publications together.

RESEARCH BACKGROUND AND PHILOSOPHY

During last 16 years, I have been actively involved in many research projects either as researcher, leader or project manager. The common objective of all of them was to pave the road for implementing the world's limited energy resources in a sustainable way. Development of more efficient and cleaner energy conversion processes were of my main interests.

Development of numerical tools and models for different physical phenomena exist in energy conversion processes have been part of my activities. I presented several models for radiation heat transfer modeling in combustion systems. I also developed several models for fluid dynamics, reaction and mass transfer in multiphase flow systems including different types of fluidized bed combustors, dense granular material, etc.

However, I strongly believe that one successful research team should not be limited to certain research topics and should always look for new ideas and challenges. By having strong knowledge in the fundamental of physics, thermodynamics, heat transfer and fluid mechanics, one can be active in different research topics.

My interest for extending my research activities is to go toward new sustainable energy sources such as solar energy and make bridge between my previous experiences and skills and the current challenges in new sustainable energy conversion systems.

Beside and by considering the concerns of energy economy, I believe that the root of improving the performance of fossil energy conversion systems including natural gas, petroleum and petro chemistry is still a valuable topic to invest and work in.

More about my research activities and interest are available in my research statement.

RESEARCH FUNDING AS WELL AS LEADERSHIP AND SUPERVISION

I have been actively involved in several research projects with the main focus on development of numerical modeling tools for heat and mass transfer in different energy conversion systems. Modeling of radiation heat transfer, gas-particle flow, chemical reactions, particle collision, Eulerian-Eulerian multiphase modeling, and discrete element method have been of my main interest. Below are some of the projects I worked in.

- **2014-2017: Clustering Innovation Competence for Future Fuels in Power Production (CLIFF)**, National TEKES and industrial funding; Project Manager, 264 000 €.
 - Development of numerical tools to implement the full spectrum correlated K-method (FSCK), and weighted sum of gray gases method (WSGG) for non-gray gas modeling in combustion systems.
 - Development of new method for non-gray gas modeling based on banded approach.
 - Implementing artificial neural network for non-gray gas modeling with banded approach.
 - Development of new method for radiation heat transfer modeling in optically thick gas particle mixture.
 - Modeling of char reaction in fluidized bed combustors in hybrid calculation with Eulerian-Eulerian two phase flow model.
 - Studying the effect of mixing limitation on chemical reaction in such systems by mean of Sherwood number.
 - Obtaining new correlation for Sherwood number in circulating fluidized bed system by using the CFD results.
- **2011–2015: Carbone Capture and Storage Program (CCSP)**, National TEKES and industrial funding; Researcher, LUT budget share: 157377 € (2011), 205 000 € (2012), 217 000 € (2013), ~200 000 €/year for 2014 and 2015.
 - Simulation of radiative heat transfer in oxy-combustion CFB furnace considering the radiation effect of gas and particle phases.
 - Study the effect of combustion type (Oxygen/Air-fired) on the heat transfer in back pass channel of CFB boilers in different scales.
 - Development of non-gray banded approach for non-gray modeling of radiative heat transfer in gaseous media using discrete ordinate method.
- **2011-2014: Future Fuels for Sustainable Energy Conversion (FUSEC)**, National TEKES and industrial funding; Principle Researcher & Project Co-Proposer, 264 000 €.

- Improvement of computational performance of classical radiative zone method.
 - Development of non-gray gas zone model to analysis radiative heat transfer in different combustion systems considering the spectral radiative properties of the combustion gases.
 - Implementation of the modified zonal code in its gray and non-gray forms to analyze radiative heat transfer in the furnace of some BFB and recovery boilers.
 - Performance analysis of different radiative numerical models.
- **2009-2012: Development of High Efficiency CFB Technology to Provide Flexible Air/Oxy Operation for Power Plant with CCS (FLEXIBURN)**
 - Development of a new weighted summation of gray gases model applicable to oxygen fired combustion products.
 - Simulation of heat and mass transfer in convection cage of a pilot scale oxygen fired fluidized bed boiler of CIUDEN.
- **2008-2012, supervision of doctoral study (Dr. Alexander Maximov)**, “Theoretical Analysis and Numerical Simulation of Spectral Radiative Properties of Combustion Gases in Oxy/Air-Fired Combustion Systems”. PhD grant from Finnish national school of CFD and Academy of Finland.
- **2008–2011: Multiphase Fluidized Bed Processes in Sustainable Energy Technologies, Academy of Finland and FORTUM; Researcher, 515 000 €.**
 - Numerical study of forming bubble and heaping in vertically vibrated granular bed.
 - Theoretical analysis and numerical simulation of spectral radiation heat transfer in combustion gases.
- **2006–2008: Radiation Heat Transfer Modeling in Industrial Furnaces** National TEKES and Industrial funding (Andritz, Foster Wheeler, Outotec); Principle Researcher & Project Co-Proposer, 170 000 €.
 - Development of theory of multiscale radiative exchange method (MREM) for solving the radiative heat transfer in fully participating media.
 - Mesh size analysis to improve the computational performance of MREM.
 - Implementation of MREM in simulation of radiative heat transfer in several CFB and recovery boilers.
- **2004-2005: Simulation of Fluid Flow in Dense Granular Materials (PhD Candidate and Researcher, 2004-2005)**. PhD grant from Finnish national school of CFD.
 - Development of an analytical model for binary collision of multi size spherical particles.
 - Finite element analyze of collision between different size granular particles.
 - Development of a set of continuum equations for numerical modeling of dense granular material with Eulerian-Eulerian approach and applying the model to a vertically vibrated granular bed.
 - Development of a discrete element model to analyze the fluid dynamics in a dense granular bed subjected to vertical vibration.

MERITS IN TEACHING AND PEDAGOGICAL COMPETENCE

- **Relevant Title:** Adjunct Professor (Docent), in radiative heat transfer in energy conversion processes, School of Energy Systems, 2016-2021.
- **Courses Taught**

Fluid mechanics, Thermodynamics, Heat Transfer, Engineering Mathematics, Computer Programming (Fortran, Vbasic), Numerical Analysis, Thermal Power Plants, etc.
- **Pedagogical Training and Competence;** the intensive course on Effective English Presentation.
- **Supervision of Doctoral Thesis;** Dr. Alexander Maximov 2008-2012.
- More about teaching is provided in my teaching portfolio.

PUBLICATIONS and PRESENTATIONS

- Peer reviewed scientific articles: 26
- Total number of journal articles in progress: 9
- Book chapter in editorial books: 1

Note that in most of publications except a few ones, I have been the first author and have done most of the research by myself.

FUNDING and ACADEMIC AWARDS

- Research mobility grant, Lappeenranta University of Technology, 2014.
- Research mobility grant, Lappeenranta University of Technology, 2015.
- Listings in Marquis Who's Who in the World 2013 (30th Edition).
- Listings in Marquis Who's Who in Science and Engineering 2011-2012 (11th Edition) and 2016-2017 (12 Edition).
- Several publication awards from Tukisäätiö (LUT), 2005-2012.
- LUT's award for the best performance between all researchers of Lappeenranta University of Technology, 2005.
- The LUT highest grade of "*Passed with Honor*" for doctoral dissertation, 2005.
- PhD student grant from the Finnish Graduate School of CFD, Helsinki, Finland, 2005.
- Academic scholarship, Lappeenranta University of Technology, Lappeenranta, Finland, 2004.
- 1st rank student of mechanical engineering of Persian Gulf University, 1998.

INTERNATIONAL MOBILITY VISIT

- Visiting professor in research group of Prof. Michael Modest's in University of California-Merced, Jan. to May 2014.
- International mobility grant from LUT faculty of tech. to visit a research group of Energy 2050 at University of Sheffield, UK in 2015.