Thermo-Fluid Dynamics Group

Modelling and simulation of thermo-fluid dynamic phenomena in energy and process technology

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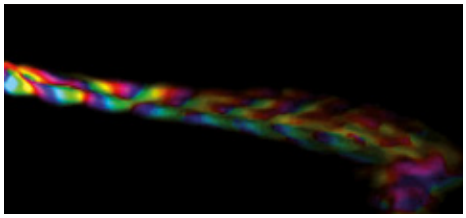
■ *Focus of the Thermo-Fluid Dynamics group in 2013-14 was the analysis and quantitative characterization of flow-flame-acoustic interactions in combustion dynamics.*

Highlights

- Organized international Summer School & Workshop 'n3l-– Non-normal and nonlinear effects in aero- and thermo-acoustics' in June 2013 with 60 participants from 15 countries, see http://www.tfd.mw.tum.de/n3l
- Prof. Arun Tangirla (IIT Madras, Indien) visted as guest professor
- Participation in the 2014 Summer Programm of the Center for Turbulence Resarch at Stanford University with two projects on identification of combustion noise and intrinsic thermo-acoustic feedback

Flow-Flame-Acoustic Interactions in Combustion Dynamics

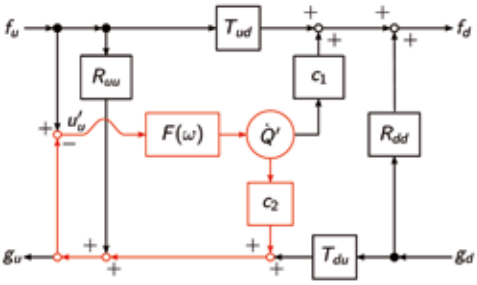
Autoignition, heat release and high-frequency combustion dynamics at elevated pressures and temperatures was investigated in several PhD research projects, funded by Alstom Power and the research initiative KW21.
Mathieu Zellhuber received the SIEMENS Energy Award 2014 for his dissertation 'High Frequency Response of Auto-Ignition and Heat Release to Acoustic Perturbations'



Distribution of intensity and relative phase of fluctuations of heat release rate of a high-frequency, tangential mode in a combustion chamber

Projects

- Alstom Twin, KW21 BY 13 GV, AG Turbo COOREFLEX-turbo 2.1.2,



Structure of the intrinsic feedback loop with characteristic wave amplitudes f,g, flow velocity u, flame transfer function F and heat release rate ˙Q

An intrinsic feedback mechanism between convective flow perturbations, heat release by the flame and acoustic waves generated by fluctuations in heat release rate was discovered. This is – as a reviewer of one of our publications remarked – 'a textbook changer'. Implications of intrinsic feedback for combustion noise, interpretation of empirical data and combustor design principles are under way.

Projects

- DFG Po 710/12, TUM-IAS Hans Fischer Fellowship

Research Focus

- Combustion dynamics
- Thermo- and aero-acoustics
- Stability analysis
- Mixing and reaction in turbulent flows
- Polydisperse multi-phase flows.

Competence

- Thermo-fluid dynamics
- Combustion modelling
- Large eddy simulation
- System identification
- Stability analysis
- Low-order acoustic modelling

Infrastructure

- Compute cluster

Courses

- Engineering Thermodynamics
- Wärmetransportphänomene
- Wärme- und Stoffübertragung
- Grundlagen der Mehrphasenströmung
- Numerische Thermofluiddynamik I
- Numerical Thermofluiddynamics II
- Computational Thermo-Fluid Dynamics with Opensource Tools

Management

Prof. Wolfgang Polifke, Ph. D.

Administrative Staff

Helga Bassett
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Research Scientists

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Alexander Avdonin, M.Sc.
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Dipl.-Ing. Sebastian Bomberg
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Lin Strobio Chen, M.Sc.
Ahtsham Ulhaq, M.Sc.
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Dipl.-Ing. Mathieu Zellhuber

Publications 2013-14

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