

# Bavarian research & innovation



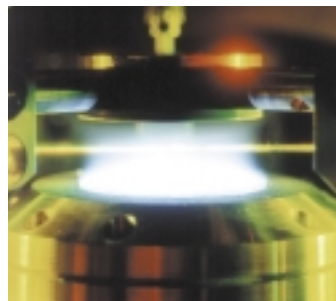
Bavarian Research Cooperation Turbulent Combustion

## BURNING TO SAVE RESOURCES

**T**he Bavarian Research Cooperation Turbulent Combustion (FORTVER) is creating the basis on which valuable fossil fuel resources can be utilised optimally and thereby conserved for a longer period. In technical applications such as burners, engines and turbines, fuel-air mixtures are formed and burnt in conditions of turbulent flow. The key to perfect combustion consists in measuring and understanding these apparently random processes and simulating them with the aid of computers.

For this purpose, FORTVER is developing modern optical, laser-assisted measuring techniques. These must be precise and fast enough to record the turbulent fluctuations that occur during formation and combustion of the mixture. The different phases are analysed: formation of an ignitable mixture, subsequent combustion and the formation of pollutants. At the same time, the structure, propagation and local extinction of flames also play important roles.

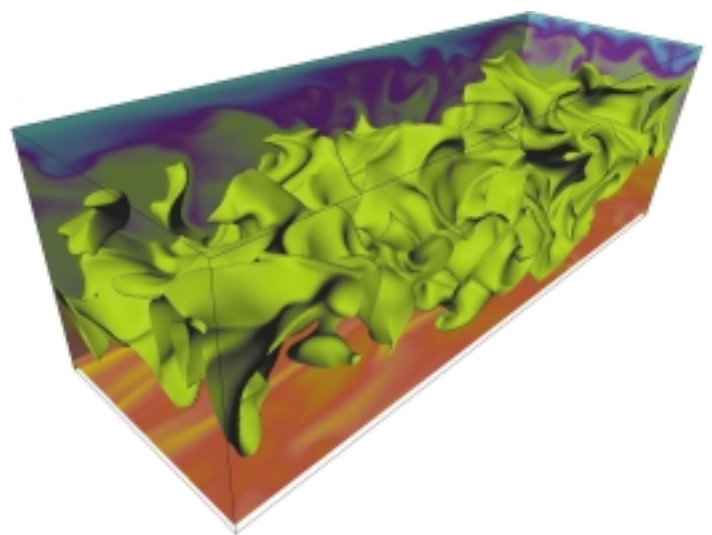
In a second project area models are developed to describe turbulent mixing and combustion processes for a more accurate prediction by computer simulation. In particular, the modern numerical process of Large-Eddy-simulation (LES) is being further



**Temperature measurement in a model flame. (Picture: T. Seeger, Chair of Engineering Thermodynamics, University of Erlangen-Nuremberg)**

developed in the Research Cooperation. Intensive collaboration and using Germany's most powerful computer, located in Munich, are essential to the success of the project. The experimentally acquired data base is used for checking simulation results, while conversely the numerical forecasts can be used to identify particularly interesting test conditions.

The Cooperation is initially formulating principles which can be easily transferred to numerous applications. Thanks to the Cooperation's contacts with industrial partners, the results obtained are quickly put to practical use. In this way, FORTVER is making an important contribution to the effective optimisation of engines, turbines, furnaces and other industrial combustion systems.



**Transport of a passive scalar in turbulent supersonic channel flow of air (Mach number = 1.5, Reynolds number = 6000). The scalar is fed in at the bottom wall and removed at the top wall. The complex structure of an instantaneous surface of the same scalar concentration is also typical of combustion processes. (Picture: H. Foyss, Fluid Dynamics Group, Technical University of Munich).**

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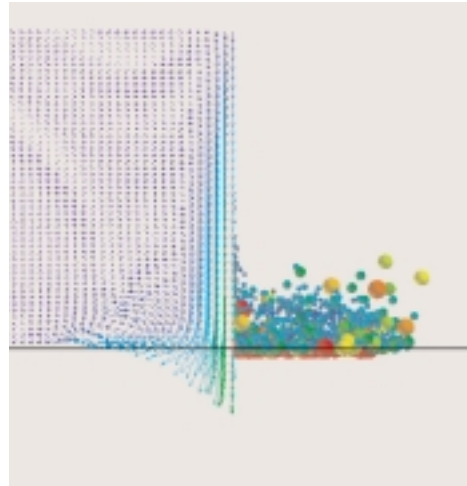
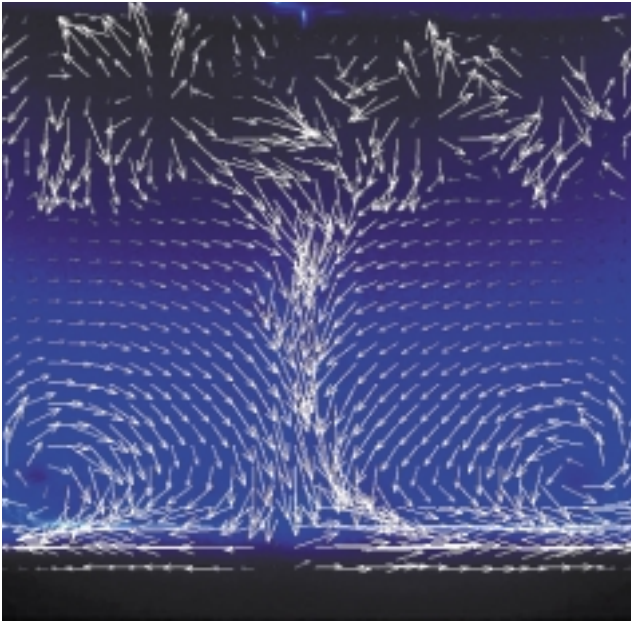
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# RESEARCH TOPICS:



**Experimentally and numerically determined velocity fields of a fuel spray impinging on a wall. (Picture: Chair of Engineering Thermodynamics and Transport Processes, University of Bayreuth)**

## Project group A: **Development of measuring techniques and experimental testing**

1. Development and implementation of laser measuring techniques for investigating mixture formation in fuel sprays (Brüggemann; University of Bayreuth)
2. Structure of inhomogeneously mixed turbulent flames with local extinction (Leipertz, Dinkelacker; University of Erlangen-Nuremberg)
3. Space/time-resolved measurement in turbulent flames (Sattelmayer, Hirsch; Technical University of Munich)

## Project group B: **Model development and numerical simulation**

1. Large-Eddy-simulation of turbulent mixing processes at low Mach numbers (Friedrich, Sesterhenn; Technical University of Munich)
2. Numerical simulation of turbulent mixing with liquid fuel injection (Brüggemann, Staudacher; University of Bayreuth)
3. Simulation of pressure influence and extinction processes in inhomogeneously pre-mixed turbulent flames (Leipertz, Dinkelacker; University of Erlangen-Nuremberg)
4. Implementation and validation of models for Large-Eddy-simulation of inhomogeneously pre-mixed turbulent flames (Polifke; Technical University of Munich)

## **Research partners**

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