LaVision
FOCUS ON IMAGING

In Application

High-Speed Scalar Laser Imaging

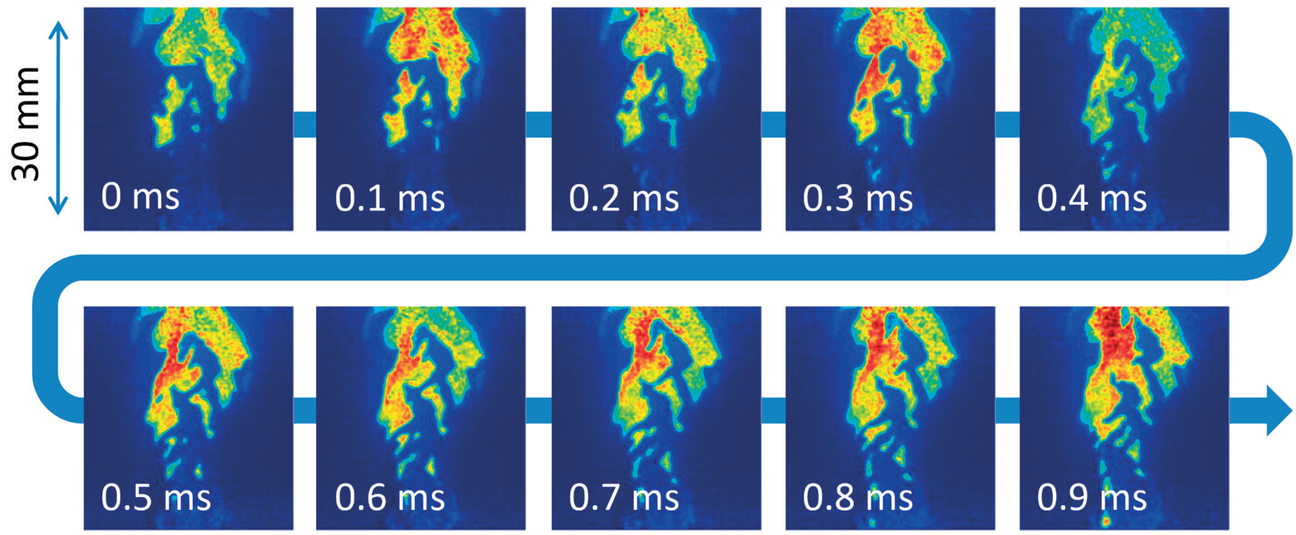
FlameMaster Tunable HS-LIF

Why high-speed imaging?

Most mixing and combustion phenomena are highly turbulent processes where diagnostic tools require high spatial and temporal resolution. Laser imaging offers excellent spatial resolution as the laser beam is spread into a light sheet precisely slicing the experimental area while the nanosecond laser pulses freeze even supersonic flows to snapshots. Megapixel cameras are able to resolve structures in the sub-millimeter range. Truly time-resolved laser imaging requires repetition rates in the kHz range to visualize the development of unsteady or statistical phenomena. These diagnostics tools have become available with the development of powerful laser sources and sensitive detection units, i.e. intensified CMOS cameras. In combination with LaVision's highly dedicated software routines and advanced synchronization units one gets now insights in complex phenomena.

Key Features and Upgrades

- **Laser sources:**
  The properties of the lasers for high-speed scalar imaging are explicitly suitable for highly efficient frequency conversion and are optimized for pumping dye lasers.
- **Modular image intensifier:**
  The modular design of the High-Speed Intensified Relay Optics (HS-IRO) adds UV sensitivity and short exposure times (fast gating) to the CMOS camera. Furthermore, weak signals of LIF processes are substantially enhanced.
- **HighSpeed Controller (HSC):**
  LaVision's fully DaVis integrated HighSpeed Controller controls the timing of all devices in the kHz domain and synchronizes the measurements to external events.
- **Post-event triggering:**
  Trigger the imaging system to randomly occurring events (extinction, backlash, etc.) and preserve the history before that event actually takes place.
- **Energy Monitor:**
  The Energy Monitor for high-speed applications is an essential device to correct for shot-to-shot variations of the laser and is capable of detecting the individual laser pulses up to repetition rates of 100 kHz.



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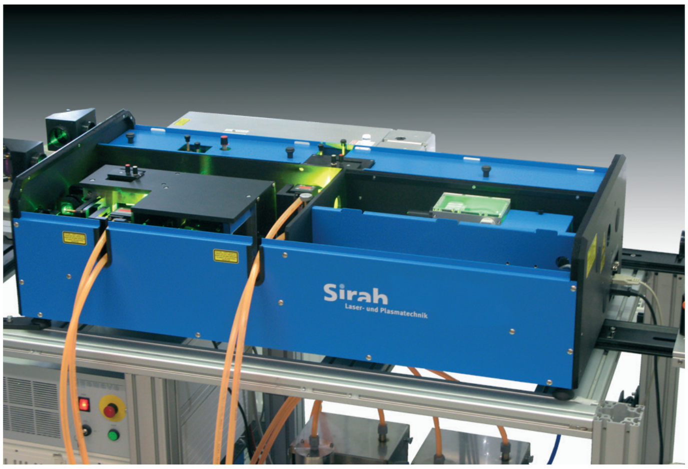
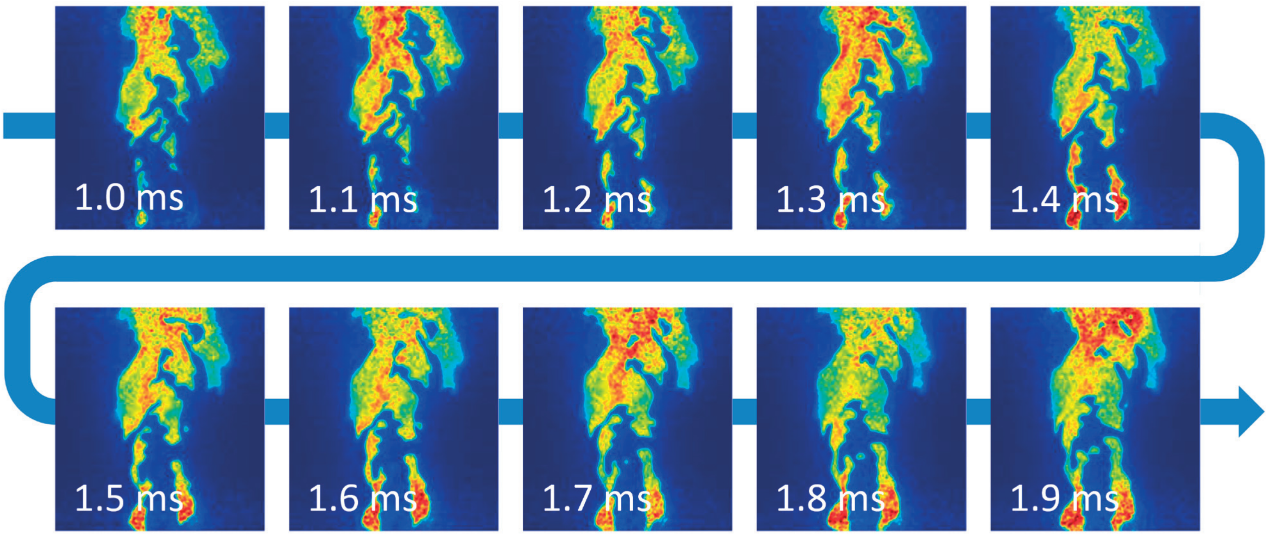
Application

- **LIF of combustion species:**
  Identification of the reaction zone via the detection of radicals like hydroxyl (OH). This requires specially designed high-speed tunable dye lasers with optimized internal optics to guarantee high efficiencies.
- **Rayleigh Scattering:**
  Determination of flame temperature and visualization of mixing processes; includes a Polarization Rotator for enhanced signal quality, fully software integrated recording and subtraction of background scattering.
- **Tracer LIF:**
  Generation of higher harmonics of the pump laser, e.g the third or fourth harmonic of an Nd:YAG laser at 355 nm or 266 nm with kHz repetition. This enables scalar imaging of seeded flows to visualize species and temperature distributions.



Experiment

A high-speed tunable dye laser system is applied to a partially premixed flame burner for detection of OH. An Nd:YAG laser operated at 532 nm with 10 kHz repetition rate and 40 W output power is used to pump the dye laser. The frequency doubling crystal of the dye laser converts the fundamental wavelength of the dye to the UV. This yields 2 W output power at 283 nm for the OH excitation. The sequence shows single shot images of the flame propagation process.



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