

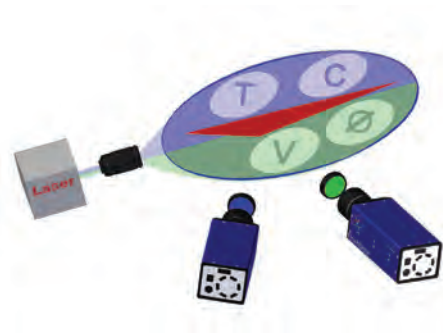
Multi-Parameter Laser Imaging

Intelligent PIV Upgrades



LAVISION

FOCUS ON IMAGING



Multi-Parameter
Laser Imaging Matrix

Laser Imaging is a powerful tool for **Multi-Parameter Flow Imaging**. LaVision combines, in a unique way, flow velocity imaging based on Particle Image Velocimetry (PIV) with imaging of scalar flow parameters such as concentration, mixture fraction, and temperature applying Laser Induced Fluorescence (LIF), Raman and Rayleigh techniques. High resolution droplet sizing and particle imaging are accomplished using Interferometric Mie Imaging (IMI) and shadowgraphic imaging, respectively. In addition, particle concentration fields are recorded using Mie scattering or Laser Induced Incandescence (LII). **Laser Imaging** builds up a complete framework of seven imaging techniques with complementary information about the flow field.

	Velocity	Concentration		Temperature	Size
		total gas	species		
PIV	✓				
LIF			✓	✓	
Rayleigh		✓		✓	
Raman		✓	✓	✓	
LII			✓		
Shadow					✓
IMI					✓

Combination of techniques captures additional flow features like:

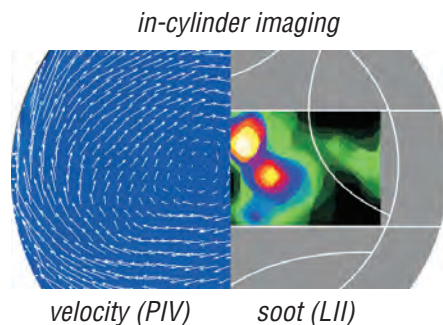
Heat Transfer, Mass Flux or Global Droplet Size

Simultaneous imaging allows instantaneous multi-parameter flow field visualization and quantification.

Imaging Techniques
Flow Field Information
Nd:YAG Laser Wavelengths

Technique	Imaged Flow Parameter		Technique
PIV	velocity		PIV
Mie, LII Shadow, IMI	particle C particle size	fuel C combustion species	LIF
Tracer LIF	C, T in <u>seeded</u> liquid flows	C, T in <u>seeded</u> gas flows	Tracer LIF
Rayleigh Raman	C, T in <u>unseeded</u> gas flows		Rayleigh Raman
λ -Laser	532	355 266	nm

C: Concentration, *T*: Temperature



velocity (PIV)

soot (LII)

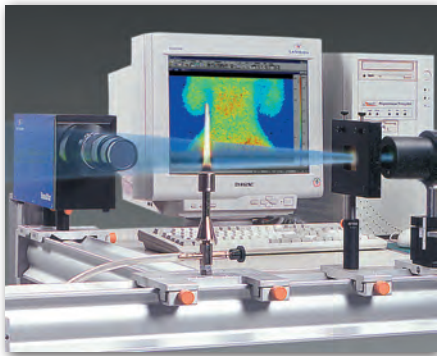
Nd:YAG PIV lasers operating at 532 nm can be upgraded for UV light sheet imaging by frequency conversion using 3rd or 4th harmonic generators. LIF imaging in gas flows needs UV excitation wavelengths. LIF imaging in dyed liquid flows is performed at 532 nm. Raman and Rayleigh imaging can be applied at any wavelengths with increasing performance at shorter wavelengths.



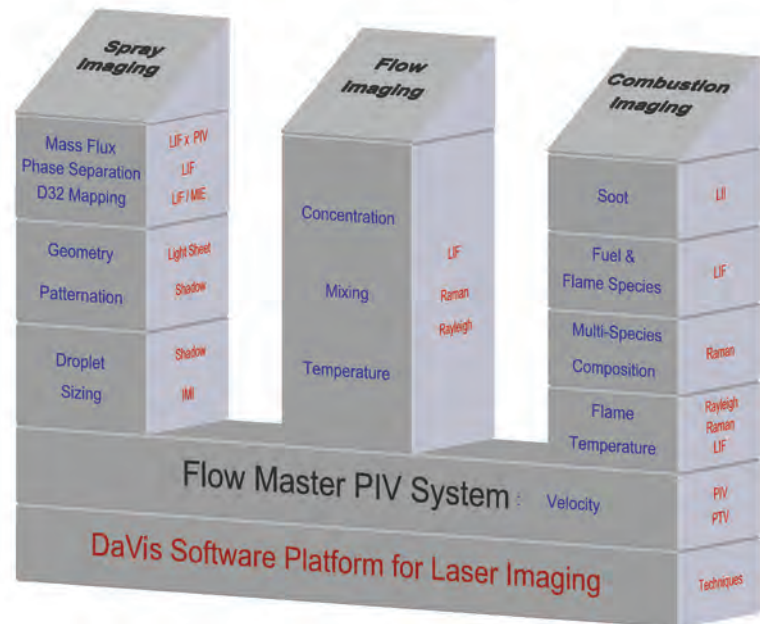
Multi-Parameter Laser Imaging

LaVision's **FlowMaster** PIV systems are the key component of this powerful **multi-parameter** flow imaging approach. For each imaged flow parameter a complete hardware and software module is provided. This modular nature of all imaging upgrades provides full flexibility for different imaging solutions.

Full System Flexibility for Different Laser Imaging Solutions



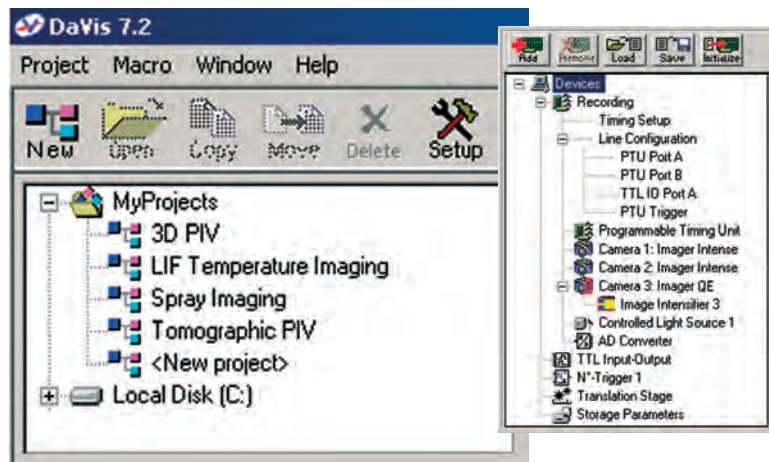
flame imaging on laser light sheets



Multi-Parameter Laser Imaging uses interchangeable hardware components and software modules. All software packages are based on the powerful DaVis imaging software platform. DaVis combines device control, image acquisition, processing and data storage.

LaVision's DaVis software concept is designed for users from the scientific as well as industrial community. Starting with the **FlowMaster** software, additional software solutions are added based on the end user's specific **multi-parameter imaging** application. The DaVis Project Manager guides you through the data acquisition and evaluation process.

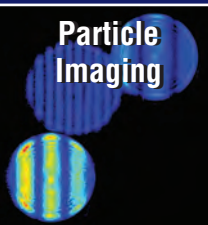

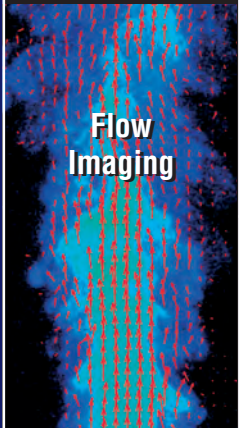
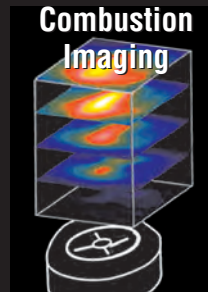
DaVis Project Manager for Laser Imaging



One Source for All Your Laser Imaging Solutions!

Only LaVision offers you this complete laser imaging product line for multi-parameter flow field imaging.

LaVision - get the whole picture!

	PIV Upgrade Modules	Hardware	DaVis Software
 Particle Imaging	Particle Sizing based on Shadow Imaging	diffuser, macro lens or long distance microscope	Shadow Sizing
	Droplet Sizing based on Interferometric Mie Imaging (IMI)	macro lens	IMI Sizing
 Spray Imaging	Spray Geometry (Patternation) based on Mie or Shadow Imaging	-----	Spray
	Spray-LIF for Mass Concentration, D32 DropSizing, Phase Separation, Mass Flux	laser UV-upgrade, intensifier, filter	Spray, D32, Exciplex, Spray Flux
 Flow Imaging	Tracer-LIF for Concentration & Temperature Imaging in <u>Seeded Liquid</u> Flows	dye set, filter	LIF LIF Temp. Calibration
	Tracer-LIF for Concentration & Temperature Imaging in <u>Seeded Gas</u> Flows	laser UV-upgrade, intensifier*	LIF LIF Temp. Calibration
	Rayleigh for Temperature Imaging in <u>Unseeded Gas</u> Flows	laser UV-upgrade*, intensifier, filter	Rayleigh Thermometry
	3D-Surface Flow (Wave Dynamics)	stereo camera setup	3D-Surface Flow
 Combustion Imaging	Raman for Gas Composition (Multi-Species) Imaging	Raman focusing optics, spectrograph, intensifier	Raman
	LIF for Flame Species Concentration Imaging: NO, OH CH, CN, C ₂ ...	tunable laser, intensifier, filter, UV-lens for OH and NO	LIF λ-Scan
	LII for Soot Concentration Imaging	intensifier, filter	LII

*recommended

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