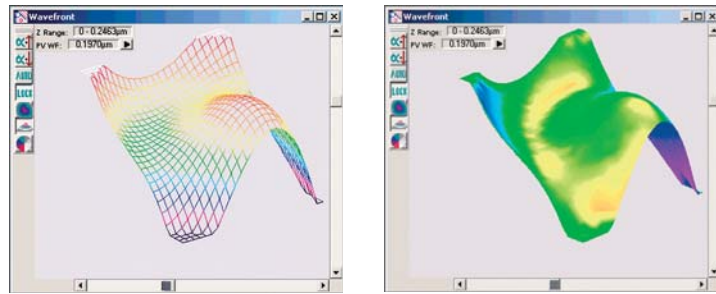


## Hartmann Wavefront Analyzer

- Measure beam wavefront easily
- Tune for beam collimation quickly
- Inspect optical components conveniently
- Capture wavefront coefficients quantitatively

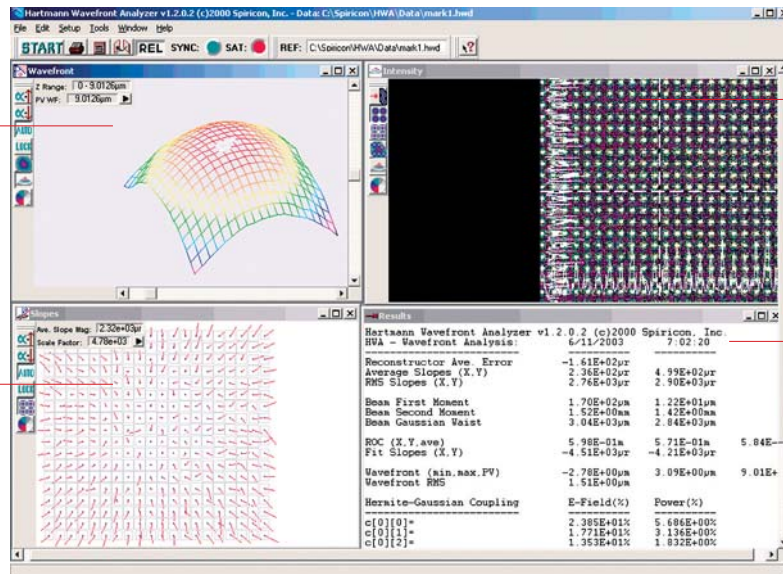
The technology and benefits of wavefront measurement are well known in the optics community. Displaying the wavefront enables rapid and precise beam collimation. Measurement of the collimated flatness and capture of wavefront coefficients for insertion into other applications enables rapid inspection of optical components and comparing current components to a reference device or specification.



Examples of a wavefront analysis. The remaining curvature existing in a flat wavefront of a beam at focus (left). The solid surface display of the same wavefront (right).

Select a Zernike or Southwell (pictured) reconstructor wavefront presentation. Set the display wavefront to automatic or locked. Rotate the image 360° and tilt it 90°.

The Slopes display presents individual wavefront measurements at each CCD cell location. Set the display magnitude to automatic or locked. Individual slopes allow exact beam alignment.



The Intensity display indicates which part of the CCD array contains the signal

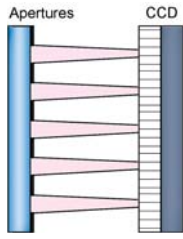
View and record real-time data results for either Zernike or Southwell (pictured) reconstructors. The number of Zernike polynomial coefficients calculated and displayed is selected in the Methods dialog box

## What is the wavefront?

Wavefront information is a valuable supplement to beam profile data. It provides the information necessary to predict possible future beam distribution. It also provides more detailed information on propagation characteristics of the beam in an optical system. Wavefront data can provide more precise information on a beam nearing focus.

The wavefront displays the direction in which a given segment of a laser or optical beam is traveling. It intuitively and directly displays which components in the beam are contributing to the beam eventually diverging from a straight line parallel collimated beam. In this sense, it presents a more detailed insight than simply measuring the divergence angle itself. The picture of the wavefront provides intuitive insight into beam structure. Calculations obtainable from a wavefront measurement provide quantitative insight into beam performance.

## How does a Hartmann Wavefront Analyzer work?



The Hartmann Wavefront Analyzer is constructed by placing an array of apertures in front of a CCD camera as shown in the figure to the left. These apertures allow light to diffract through the plate onto the CCD. The segments of the beam that pass through the apertures will land in a position displaced from the center position, based on the direction of travel, or the phase of that part of the beam. The CCD camera measures the phase of each spot by measuring this displacement. Software algorithms then reconstruct a wavefront for the entire beam.

## Specifications Hartmann Wavefront Analyzer with a Cohu 4812 Camera

Specifications	High Resolution			Multi-Purpose			High Sensitivity		
Wavelength (nm)	1064	633	300	1064	633	300	1064	633	300
Aperture spacing ( $\mu\text{m}$ )	200	200	200	280	280	280	350	350	350
<b>Spatial Resolution</b>									
# of Apertures X/Y	43/32	43/32	43/32	30/23	30/23	30/23	24/18	24/18	24/18
<b>Single Aperture Slopes</b>									
Minimum Slope, RMS (microradians)	350	179	92	128	66	35	65	39	18
Maximum Slope (microradians)	32	15	8	23	11	6	18	10	5
Slope Dynamic Range	90	83	87	178	163	175	273	272	273
<b>Full Array Wavefront Radius of Curvature</b>									
Minimum ROC (cm)	19	41	77	27	57	100	34	58	122
Maximum ROC (m)	18	34	67	48	93	175	94	159	333
RMS Wavefront Error ( $\lambda$ )	1/5	1/6	1/5	1/10	1/11	1/10	1/16	1/16	1/15
Maximum Phase Difference at Max Spatial Period ( $\mu\text{m}$ )	4.0	1.9	1.0	4.1	1.9	1.1	4.0	2.3	1.1

Laser Power  
& Energy

Heads

Displays

Beam Profile  
Wavelength

OEM Products

## Beam Analysis Systems for Industrial Lasers

BA Series for beam analysis, power, energy and temporal profile		
BA150	BA150 system for beam profile, pulse shape, power and energy including USB Interface box for transmitting power/energy information to PC. To be used with oscilloscope of user's choice. Includes interchangeable -100mm lens assy and -50mm lens assy.	SP786012
Replacement -100mm lens assembly	Replacement - 100mm lens assembly for BA150	SPZ08256
Replacement -50mm lens assembly	Replacement - 50mm lens assembly for BA150	SPZ08255
BA500-V2	BA500 system for beam profile, pulse shape, power and energy including SP620 USB camera and USB Interface box for transmitting power/energy information to PC. To be used with oscilloscope of user's choice.	SP786013
BA500-V1 for laptop	As above but with FX50 firewire camera and cardbus firewire card for laptop PC. not RoHS	SP186007
BA500-V1 for desktop	As above but with FX50 firewire camera and PC firewire card for desktop PC. not RoHS	SP186008
Optional Carrying case for BA500	Carrying case for BA500 unit, optional Picoscope, cables and firewire card	1J02048
Optional Water circulator for BA500	Portable 30 liter reservoir water circulator. For operation at 300W for up to 1Hr, at 1000W for 20 minutes. not RoHS	1Z17100
BA100-V1 for laptop	Complete pass through system for beam profile including Cardbus firewire card for installation in user's laptop PC. User must provide beam stop or power meter.	SP186009
BA100-V1 for desktop	Complete pass through system for beam profile including PCI firewire card for installation in user's desktop PC. User must provide beam stop or power meter.	SP186010
L40(150)A-V2 laser power meter for BA100	Laser power meter for 40W continuous and 150W intermittent average power to be used as a beam stop and for measuring laser power and single shot energy. (Higher power meters also available).	7Z02626
Optional PC oscilloscope	1MHz virtual oscilloscope for BA150 or BA500 to turn your PC into an oscilloscope displaying the temporal pulse shape. Uses PC or laptop USB port.	SPE10008
Optical trigger assembly for BA100	Optical trigger assembly, which can be mounted on head or separately to sense laser pulses and synchronize camera with pulses. Comes with short BNC cable for mounting on camera, and for mounting separately, a stand (with BA150 and BA500 this is built in)	SPZ17005
YAG Max	Call for details	
IPB-YAG-16	Nd:YAG sampler for 1064nm beams up to 4KW, beam width up to 16mm	SP90150
IPB-YAG-30	Nd:YAG sampler for 1064nm beams up to 4KW, beam width up to 30mm	SP90151

## II-VI-CO<sub>2</sub> Profilers for Industrial CO<sub>2</sub> Lasers

II-VI-CO2-BS-35	II-VI-CO2 in-line sampler, for 10.6µm beams up to 8 kW. Beam width up to 20 mm. Pyrocam III Beam Profiler System required (ordered separately). Recommended model: PY-III-C-A or PY-III-C-B with a Germanium 10.6µm window. Optional LBA-PC-PIII laser beam analyzer also ordered separately.	SP90062
II-VI-CO2-58-D8-WC-H	CO2 laser beam sampler for lasers up to 10kW. Input Clear Aperture is 58mm. Requires cooling water. Horizontal entry. Built-in 8x beam reducer and adapters for Pyrocam III. Order Pyrocam III separately. Optional LBA-PC-PIII laser beam analyzer also ordered separately.	SP90160
II-VI-CO2-58-D8-WC-V	Same as above but with Vertical Entry	SP90161
Consult factory for larger beams		

## Hartmann Wavefront Analyzer

HWA-C4812-10-HR-1064	High resolution at 1064nm. Includes HWA software, COHU 4812 camera, Framegrabber card, Hartmann array permanently mounted on camera.	SP90063
HWA-C4812-10-MP-1064	Multi-purpose at 1064nm. Includes HWA software, COHU 4812 camera, Framegrabber card, Hartmann array permanently mounted on camera.	SP90064
HWA-C4812-10-HS-1064	High sensitivity at 1064nm. Includes HWA software, COHU 4812 camera, Framegrabber card, Hartmann array permanently mounted on camera.	SP90065
HWA-C4812-10-HR-633	High resolution at 633nm. Includes HWA software, COHU 4812 camera, Framegrabber card, Hartmann array permanently mounted on camera.	SP90066
HWA-C4812-10-MP-633	Multi-purpose at 633nm. Includes HWA software, COHU 4812 camera, Framegrabber card, Hartmann array permanently mounted on camera.	SP90067
HWA-C4812-10-HS-633	High sensitivity at 633nm. Includes HWA software, COHU 4812 camera, Framegrabber card, Hartmann array permanently mounted on camera.	SP90068
HWA-C4812-10-HR-300	High resolution at 300nm. Includes HWA software, COHU 4812 camera, Framegrabber card, Hartmann array permanently mounted on camera.	SP90069
HWA-C4812-10-MP-300	Multi-purpose at 300nm. Includes HWA software, COHU 4812 camera, Framegrabber card, Hartmann array permanently mounted on camera.	SP90070
HWA-C4812-10-HS-300	High sensitivity at 300nm. Includes HWA software, COHU 4812 camera, Framegrabber card, Hartmann array permanently mounted on camera.	SP90071