

Fourier Optics Experimenter

Incorporating the *Fourier Transform Engine*® and patented Optical Correlator technology

One tool, endless uses for innovative optical processing

Optics is playing an increasingly significant part in our everyday lives. As the global thirst for handling, processing and storing large amounts of data continues to surge at an ever expanding rate, the suitability of electronic solutions begin to decline. Physical boundaries are approached. Power consumption becomes impractical. Heat outputs are unmanageable. The massive processing power on offer from optical systems can provide a solution to this demand and provide next generation solutions in a wide range of industrial and commercial areas.

Promising technologies such as optical correlation, holographic data storage and optical switching are set to provide much needed step performance boosts in areas where electronic systems are already beginning to show their limitations. But how can students and researchers discover for themselves the new optical paradigms?

Teaching of optics, specifically Fourier Optics, has been largely confined to specialist courses, with little or no practical support to lecturers and professors to introduce the concepts to a new generation of engineers. **Until Now.**

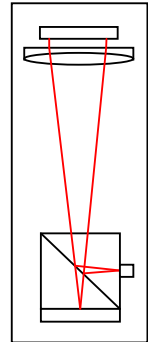
FOE2.0 Configuration



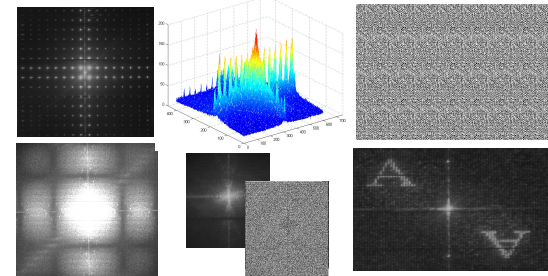
The Fourier Optics Experimenter allows students and researchers to practically explore a range of topics based around the Optical Fourier Transform. With an easy to use Windows software package and Matlab interface, the FOE provides an essential insight into the world of Fourier Optics.

At the heart of the Experimenter is the **Fourier Transform Engine**® - a compact, Optical Fourier transform stage, comprising of a megapixel liquid crystal Spatial Light Modulator (SLM),

CMOS camera sensor and lens system. Collimated low power laser light is supplied via a single mode pigtail fibre and acts as the information carrier.



The system is driven from a custom **Windows platform**, featuring an intuitive GUI that allows users to create and upload images to the SLM in a variety of configurations. Also supplied is a **Matlab interface** which allows the FOE to be called as a Matlab "oft()" function.

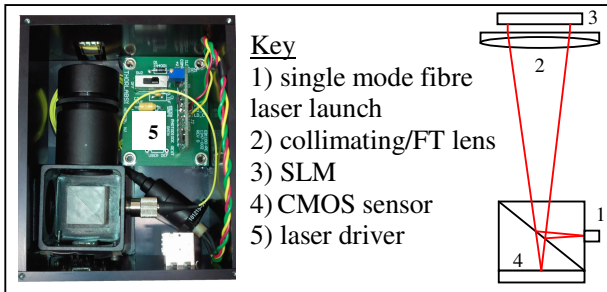


Cambridge Correlators Ltd. originated in Cambridge University's Engineering Department. Its extensive knowledge and expertise in Fourier optics, optical correlators and liquid crystal devices has resulted in this unique system, essential equipment for every physics and engineering laboratory.



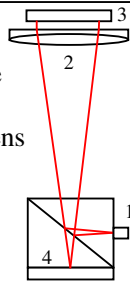
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Key

- 1) single mode fibre laser launch
- 2) collimating/FT lens
- 3) SLM
- 4) CMOS sensor
- 5) laser driver



Optical Correlation

By configuring the software to produce a second FT, the kit also doubles as a 1/f Joint Transform Correlator (JTC) – a powerful pattern recognition system capable of detecting objects in cluttered scenes, automated inspection, image searching and motion tracking.

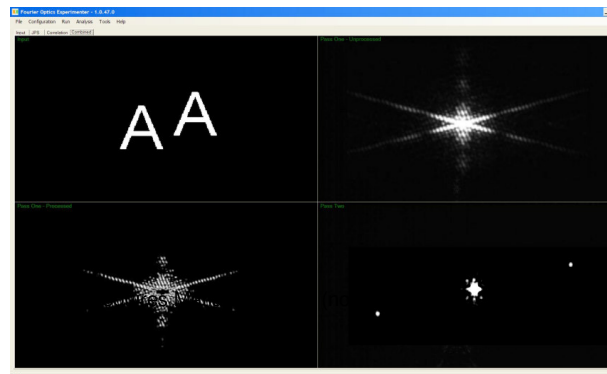
The correlator performs comparisons of large data sets such as high-resolution images, providing a measure of similarity and relative position between objects within the input scene. This allows large images to be quickly analyzed; input images to be compared to large reference libraries; or movement within successive video frames to be tracked.

Data is addressed to the SLM via VGA interface and projected through the optical system. The CMOS USB sensor then captures the intensity distribution of its Optical Fourier Transform.

Teaching the principles of Fourier Optics

The kit may be used in conjunction with teaching courses to practically demonstrate some of the fundamental principles of Fourier and Diffractive optics, including:

Fraunhofer (Far Field) Diffraction Theory
Computer Generated Holograms
OFT vs FFT
Fourier transform properties
Huygen's Wave Principle
Young's Slits
Sinc Functions
Shift invariance



Screenshot showing each stage of a 1/f Joint Transform Correlation process

Software Functions

Multiple Image importing
Video importing
External USB camera input interface
Region of Interest control
Threshold controls
Sequential FT/correlations
Matlab Interface

(*requires Matlab license and installation, not included)

PC/laptop System Requirements

OS	Windows XP home/Pro
Output	USB2
Graphics	VGA
Processor	Intel 2GHz minimum
Memory	1GB
Hard Disk	100GB

The Fourier Optics Experimenter may be used to show a fascinating glimpse of how Fourier optics is a vital part of our future, from biometric security, to optical switching in telecommunications and medical image analysis.

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Technical Specifications:

SLM	
Resolution	1024x768
Bit-depth	8-bit
Pixel pitch	9x9um, 0.45" dia
Reflectance	62% at 633nm
Operating temperature	0-50 degrees Celsius
Active area dimensions	9.3x7mm
LC	
LC	Twisted Nematic Mode
Operating Wavelength	430-650nm
Input Polarisation	Parallel with longest side
Contrast Ratio	350:1
LC response time	200us
Interface	VGA
Input voltage	5V DC
Retardation	~0.8pi at 633nm
CAMERA	
Interface	USB2
Max Frame rate	Up to 87fps
Resolution	752x480 pixels
Output	8-bit output
LASER	
Type	635nm laser diode launch with pigtail single mode fibre
Power	2.5mW variable output

Cambridge Correlators is developing its patented optical correlator technology for a range of application areas.

Development programs, consultancy and technical support are available for specific applications.

High performance greyscale and binary systems are currently in development.

Cambridge Correlators would like to hear from customers with suggestions and ideas for further content to be added.

Please contact us for current pricing.

Suggested Topics:

<i>Optical Correlation</i>	<i>Fixed phase gratings and optical keys</i>
<i>Phase vs Intensity Modulation</i>	<i>Real-time Motion Tracking</i>
<i>Holographic Data Storage</i>	<i>Real-time Object Tracking</i>
<i>Frequency Noise removal</i>	<i>MPEG decomposition on video sequence</i>
<i>Laser Properties</i>	<i>Biometric Recognition</i>
<i>Dispersion Correction Principles</i>	<i>Print Inspection</i>
<i>Aberration Correction Principles</i>	<i>Medical Analysis</i>
<i>Wavelength Division Multiplexing</i>	<i>Cluttered Images</i>
<i>Adaptive optics</i>	<i>1:n telecom switching</i>
<i>Optical Encryption</i>	<i>Hologram generation</i>
<i>Beam steering</i>	<i>Optical Tweezers</i>

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