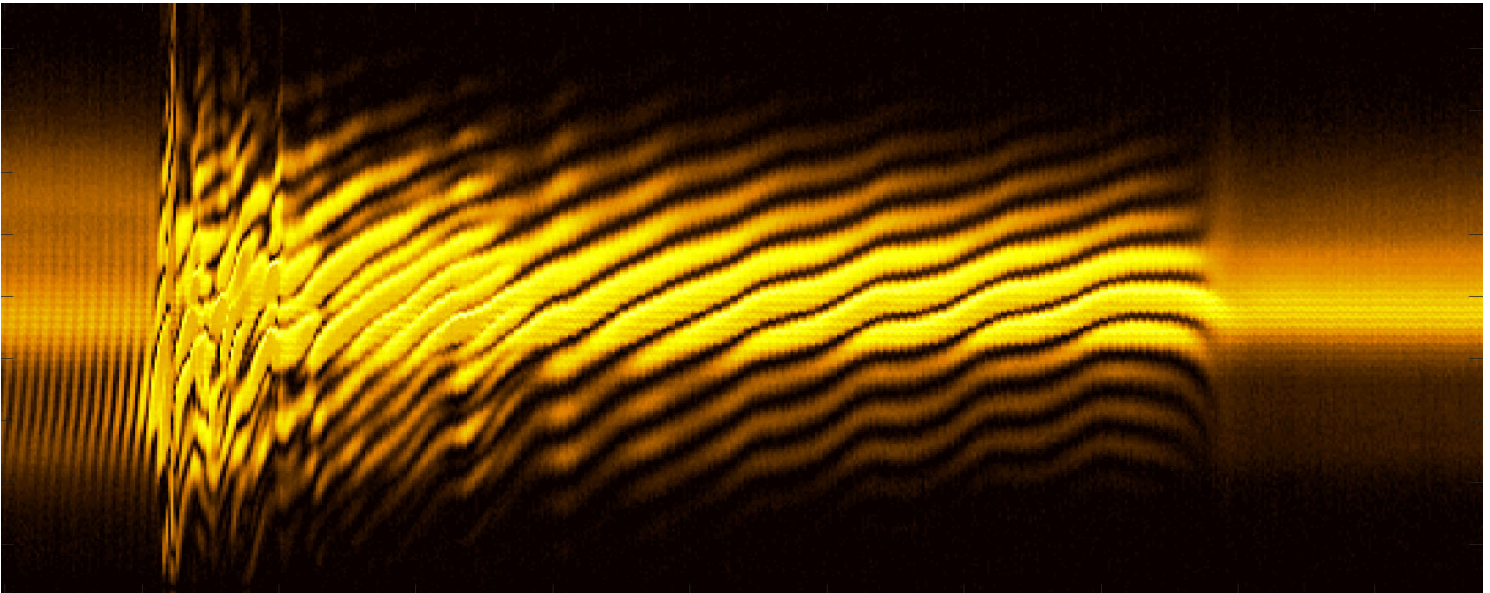


## Tachyonics Inc.: Ultrafast Signal Measurement and Imaging

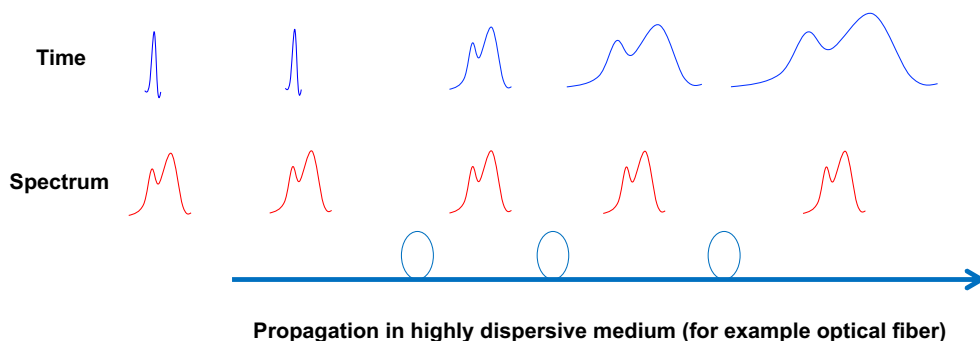


*Evolution of a laser spectral transients*

Tachyonics Inc. develops novel real-time instruments capable of capturing single-shot events with frame rate of up to 1 Billion frames per second. Our instruments allow capturing rare events and transients in photonic systems. Our instruments are supported by our advanced software tools for real-time capturing, processing, analyzing and visualizing the Big data created by these ultrafast detection instruments. Tachyonics Inc. also provides consultation for the design and development of ultrafast detection systems. Our expert team at Tachyonics Inc. has more than 12 years of experience designing such systems.

### OUR TECHNOLOGY

When an optical signal passes through a highly dispersive medium, optical spectrum is mapped to the time domain, this means optical signal at the output in the time domain looks like the input optical spectrum. At the same time, the signal is stretched and slowed down in the time domain so it can be captured using conventional oscilloscopes. By using dispersion in a highly dispersive medium, optical signal spectrum can be captured in real-time and single-shot. This concept is called "Optical Time-Stretch".



Tachyonics Inc. has commercialized the spectrometer that works based on optical time-stretch, called *COMET*. *COMET* is the fastest spectrometer in the world capable of operating at up to 1 Billion frames/sec, orders of magnitude faster than any other spectrometer.

- ✓ Tachyonics Inc holds multiple patents on *COMET* and its applications.
- ✓ *COMET* is fully designed and made in USA.

## APPLICATIONS OF COMET AS SPECTROMETER

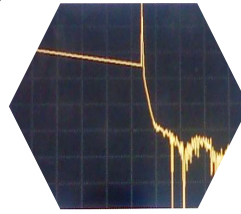
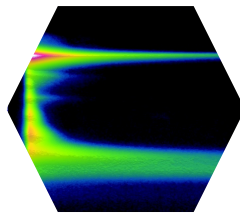
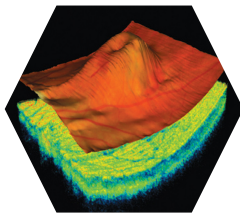
- Laser transients, non-repetitive dynamics of laser mode locking, Q-switching, solitons, spectral stability
- Rare events in optical systems
- Measurements of fast stochastic processes
- Capturing non-Gaussian statistics that are signature of complex dynamics
- Modulation Instability
- High through-put spectroscopy
- Study of optical Rogue waves

## APPLICATIONS OF COMET AS PERFORMANCE BOOSTER FOR OTHER INSTRUMENTS

COMET is a core to many other applications of interest. For more information please contact [info@tachyonicsinc.com](mailto:info@tachyonicsinc.com)

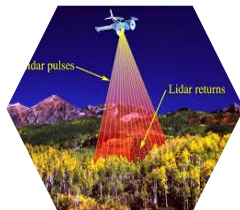
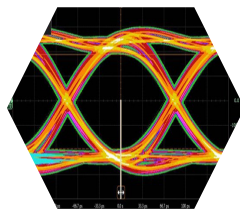
### Ultrafast Cameras

Biomedical  
Imaging



Reflectometry

Wideband  
Digitizers



LIDAR

Ranging &  
Vibrometry

## Newest Products:

# COMET I: Single-Shot Billion Frame-Rate Optical Spectrometer

*COMET I* is a real-time single-shot optical spectrometer with a frame rate of up to billion frames per second, at least one thousand times faster than the next fastest spectrometer. The *COMET* real-time capability is enabled by Optical Time-Stretch. The *COMET* can capture large data sets to reveal optical dynamics and rare events with high accuracy. *COMET I* is currently the most cost-effective solution for time-stretch spectrometer.

*COMET I* employs new technology to measure real-time single-shot spectra with absolute wavelength information. Conventional time-stretch systems can only reveal relative wavelength information.

*COMET I* allows the user to fully control the digitizer and communicate with it using Ethernet, WIFI, or GPIB port for high-speed data transfer. This automated capturing, processing and visualization tool makes the study of complex events very convenient and fast.

*COMET I* benefits from our patented technology to do unprecedented variable frame-rate spectral measurements from 0.01 frames/second up to billion frames/second allowing the user to study complex events at different speeds.

With more than a decade of experience in our team for designing time-stretch systems, *COMET I* components are selected from top brands and are specially designed for high-performance and high-sensitivity.

*COMET I* comes with very powerful software, called *COMET*, which allows the user to perform sophisticated mathematical operations and post-processing on the captured data. It also provides a variety of visualization tools.

*COMET I* software uses parallel processing and hardware acceleration to process the Big Data generated by the *COMET* instrument at unprecedented processing speeds.



## FEATURES

- ✓ Real-time single-shot (no sweeping) at extremely high capture rate: up to 1 billion frames/second
- ✓ Can capture up to millions of constitutive pulse spectra in single shot
- ✓ Wide spectral single-shot Bandwidth: up to 650nm
- ✓ High spectral resolution: > 10pm
- ✓ High sensitivity: as low as  $\mu\text{W}$
- ✓ All fiber-based for rugged and field-use

## COMET II: World's Most Advanced Time-Stretch Spectrometer

COMET II expands the capabilities of COMET I and is currently the most advanced time-stretch spectrometer in the world.

COMET II has an embedded computer to capture, process, and analyze streaming COMET spectral information and has a beautiful 7" HD touch-screen monitor to visualize spectral transients and more. This makes working with COMET instrument very convenient and user-friendly.

COMET II has an embedded 5G WIFI router allowing it to become a hotspot. COMET hotspot tool enables high-speed wireless data communication with cloud/remote processors to process large data-sets. COMET II hotspot also allows to control the digitizer remotely, perform high-speed data transfer with digitizer, or operate multiple COMET II instruments remotely (screen-mirroring) and simultaneously.

COMET II has another unprecedented feature: it allows the user to choose between 7 spectral resolution settings (COMET I has only 2 spectral resolution settings) which enable the user to employ COMET II for virtually any application of interest.

COMET II has an input signal power indicator on the screen and makes sure input power does not go beyond maximum ratings.

With all these new capabilities, COMET II has the same form factor as COMET I.



### FEATURES

- ✓ Real-time single-shot (no sweeping) at extremely high capture rate: up to 1 billion frames/second
- ✓ Can capture up to millions of constitutive pulse spectra in single shot
- ✓ Wide spectral single-shot Bandwidth: up to 650nm
- ✓ High spectral resolution: > 10pm
- ✓ High sensitivity: as low as  $\mu\text{W}$
- ✓ All fiber-based for rugged and field-use
- ✓ 7 resolution settings (minimum and maximum resolution can be custom-built for user)
- ✓ Built-in computer
- ✓ Built-in 7" HD touch-screen monitor
- ✓ Built-in 5G WIFI router
- ✓ Built-in input power indicator on the monitor

**SOFTWARE**

The *COMET* spectrometer comes with powerful software for real-time capturing of large datasets and advanced signal processing. It works on major operating systems such as Mac OS and Windows. The software analytical capabilities include advanced synchronization tools, 2D and 3D spectral transients' visualization, playback movie of transients, spectral persistence evolution, spectral statistics, and variety of mathematical operations.

**SPECIFICATIONS**

<b>OPTICAL AND ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)		
	<b>COMET I</b>	<b>COMET II</b>
Wavelength Range	650 nm – 1000 nm <sup>1</sup> & 1000 nm – 1650 nm <sup>1</sup>	
Spectral Bandwidth	< 650 nm	
Spectral Resolution	>10 pm, 2 resolutions	>10 pm, 7 resolutions
Absolute wavelength	Yes	
Acquisition Frame Rate	User-set from 0.01 frames/sec to 1 billion frames/sec	
Temporal Range	<300 ps, 2 settings	<300 ps, 7 settings
Temporal Resolution	>15 fs, 2 settings	>15 fs, 7 settings
Pulse Complexity	TBWP < 20,000, 2 settings	TBWP < 20,000, 7 settings
Optical Input Sensitivity	50 $\mu\text{W}$	
Maximum Optical Input	10 mW <sup>2</sup>	
Input Power Indicator	No	Yes
Touchscreen monitor	No	Yes
WIFI Hotspot, Wireless Communication	No	Yes
Intensity Accuracy	3%	
Input Polarization	Not required	
Input Fiber Type	Single-mode Fiber	
Fiber Connector Type	FC/APC	
Electrical Power Supply	90 to 270 VAC, 50/60 Hz	
Dimensions (WxHxD) and Weight	14.33"x5.79"x13.03", 10 lbs.	14.33"x5.79"x13.03", 15 lbs.

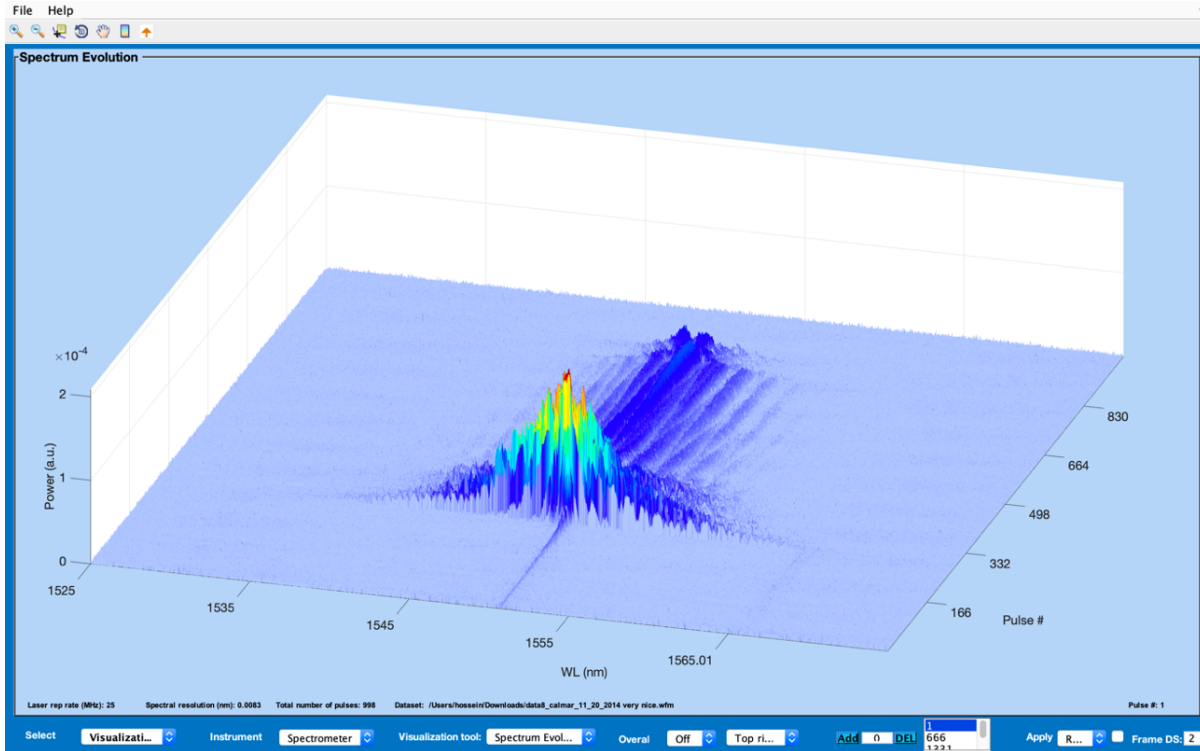
**Note**

1. We are able to custom build *COMET* instrument with wider bandwidths as stated here, please contact Tachyonics Inc. for more information.

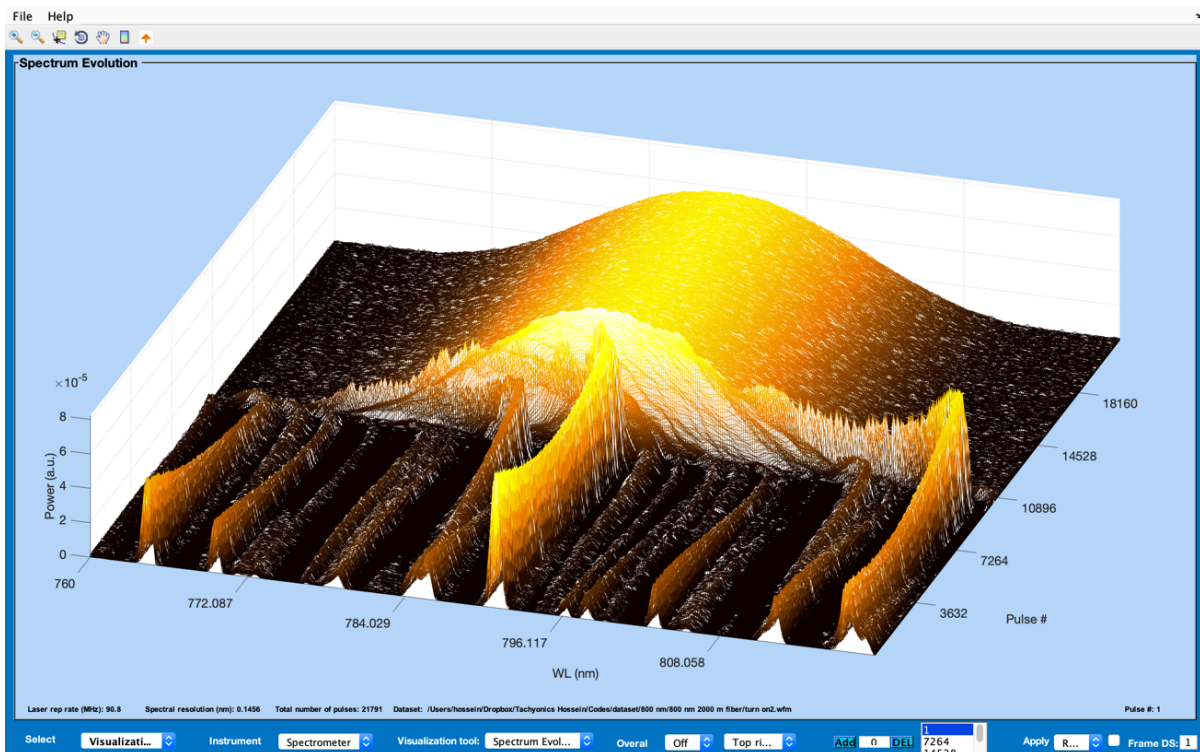
<b>MINIMUM SOFTWARE REQUIREMENTS</b>	
Operating System	Windows, Mac OS, 32-bit or 64-bit
Processor (CPU)	1 GHz processor
Memory	1 GB of RAM
Storage	160 GB HDD or 32 GB SDD

SAMPLE APPLICATIONS

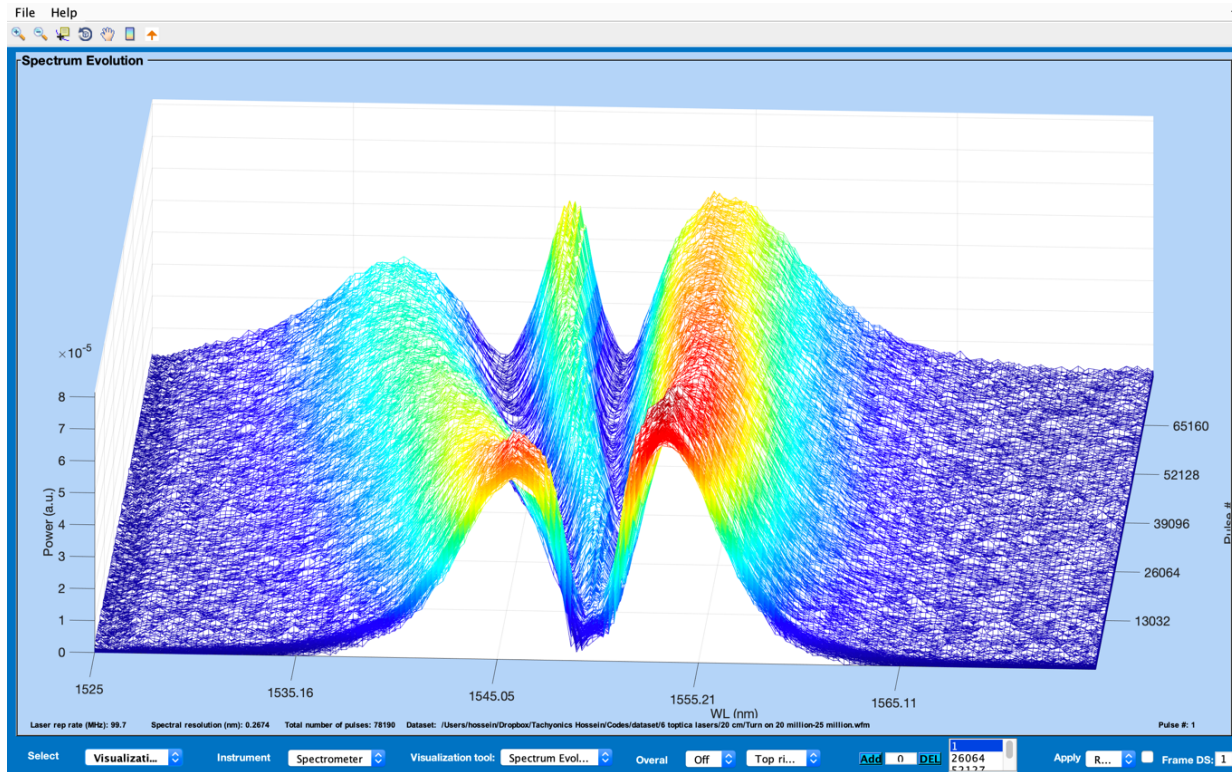
500 single-shot spectra during a Q-switching event is captured at 25 Million frames/sec over 20  $\mu$ s.



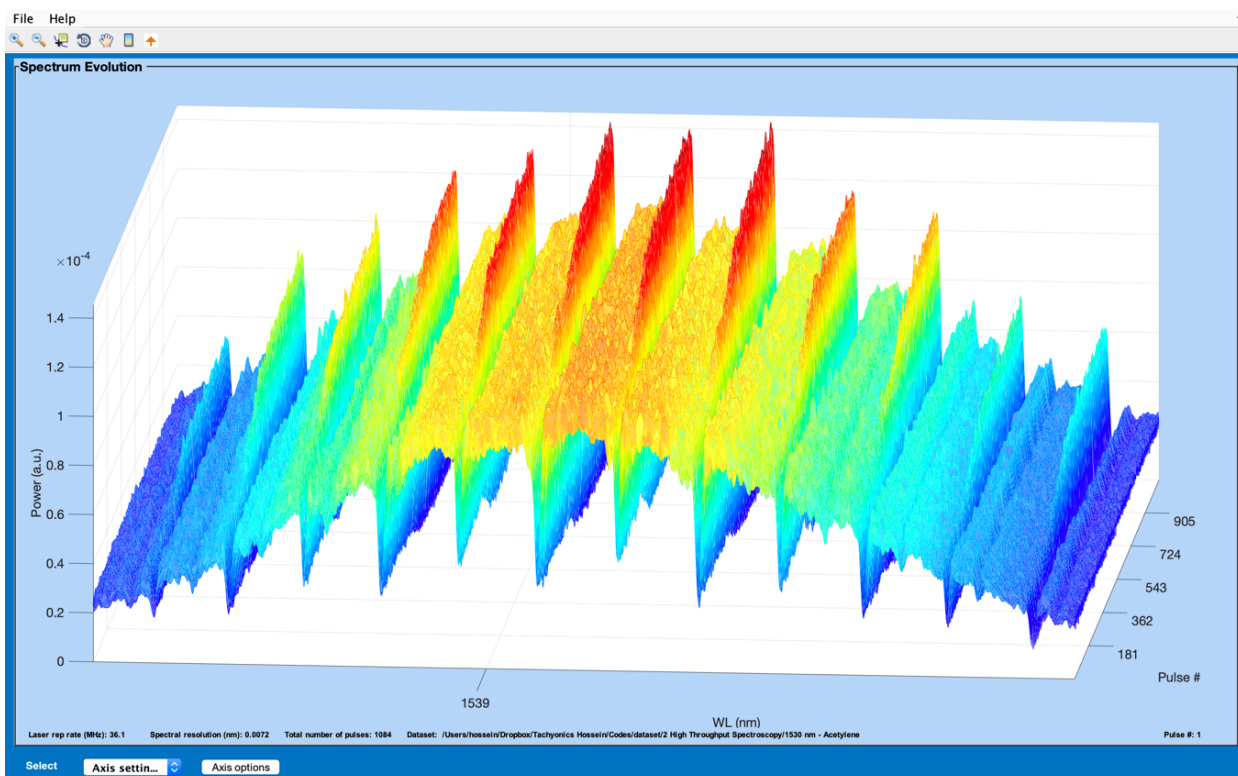
20,000 Single-shot spectra of turn-on transients, Ti-Sapphire laser, captured at 90.8 Million frames/second.



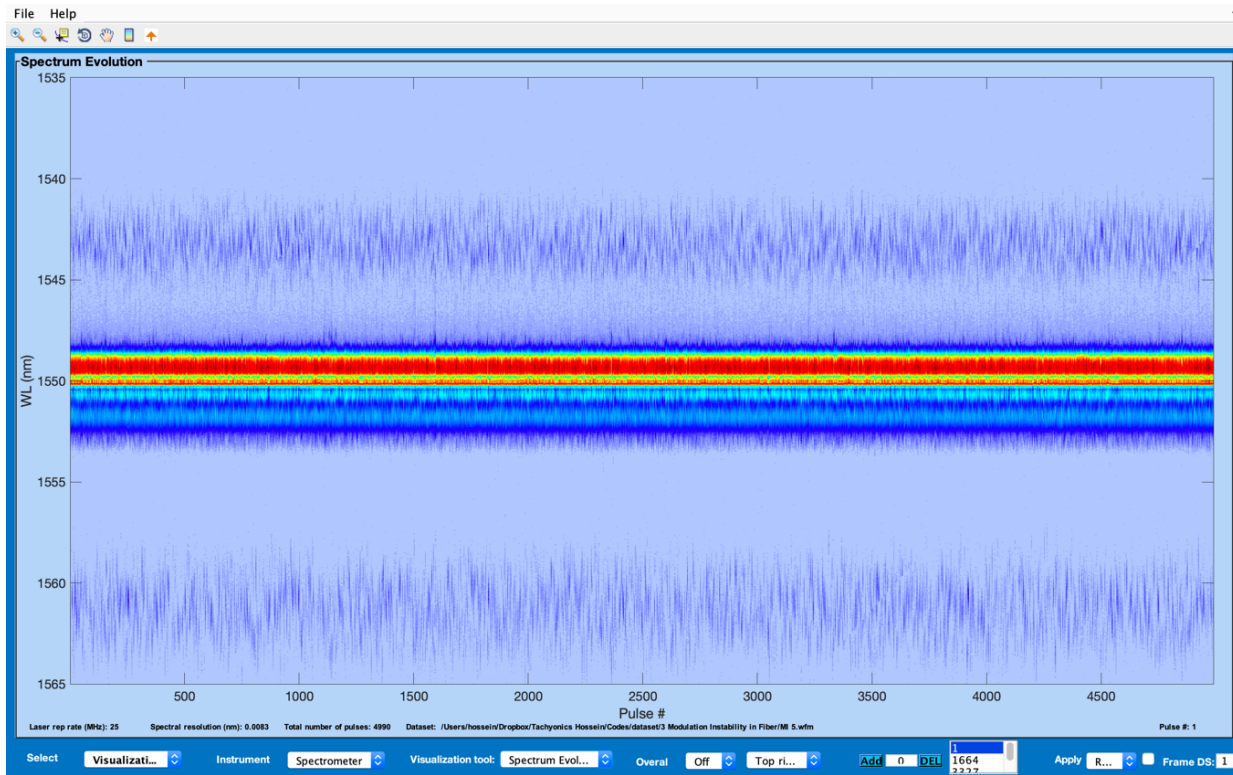
**Spectral evolution of a supercontinuum laser during turn on event captured by COMET spectrometer.**



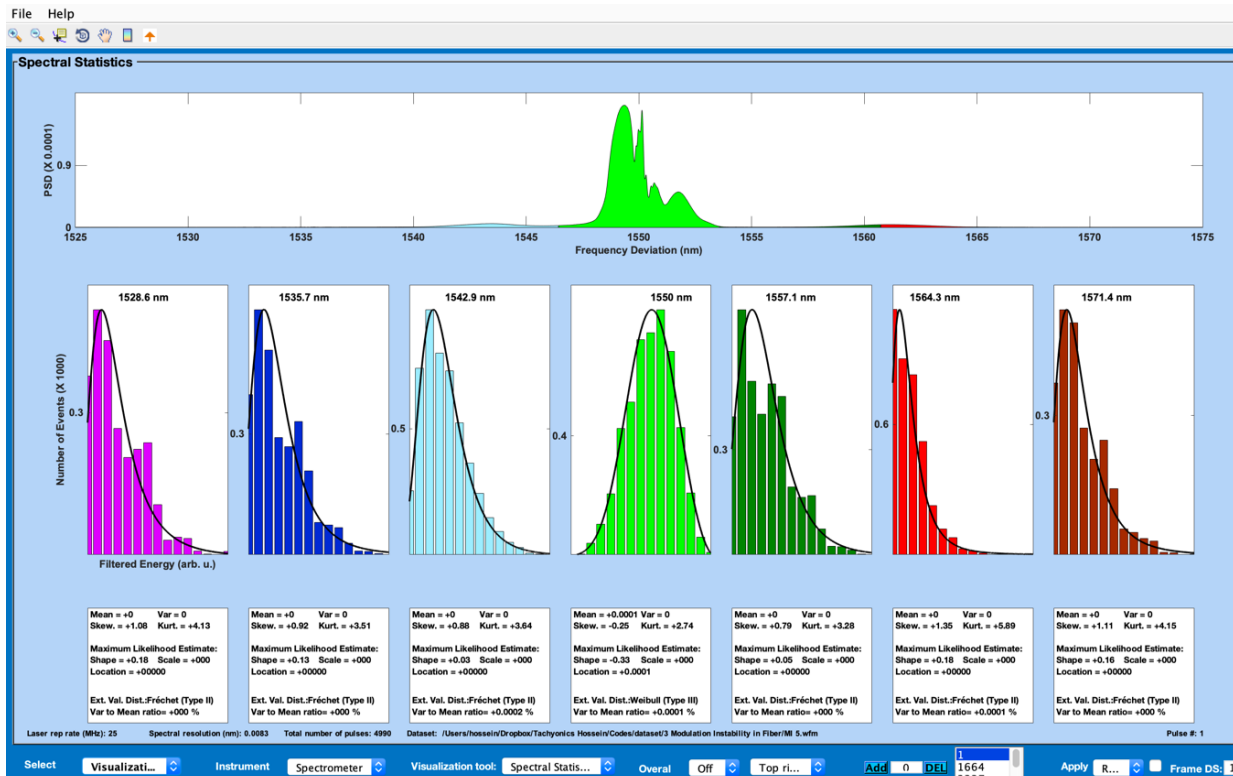
**Single-shot transient of Acetylene gas absorption spectra captured at 36.1 Million frames/sec.**



**Spectral evolution of an unstable laser during a non-linear process analyzed by COMET software.**

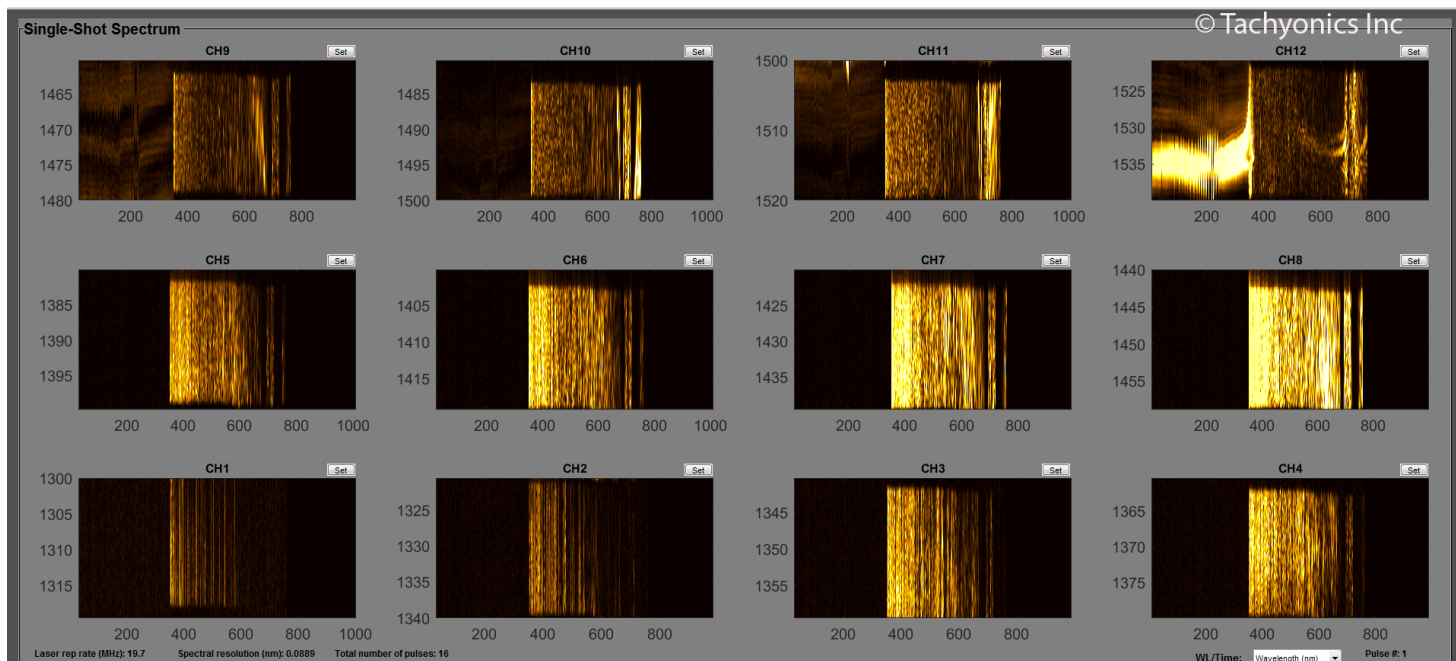


**Spectral statistics of the above non-linear process analyzed by COMET software.**

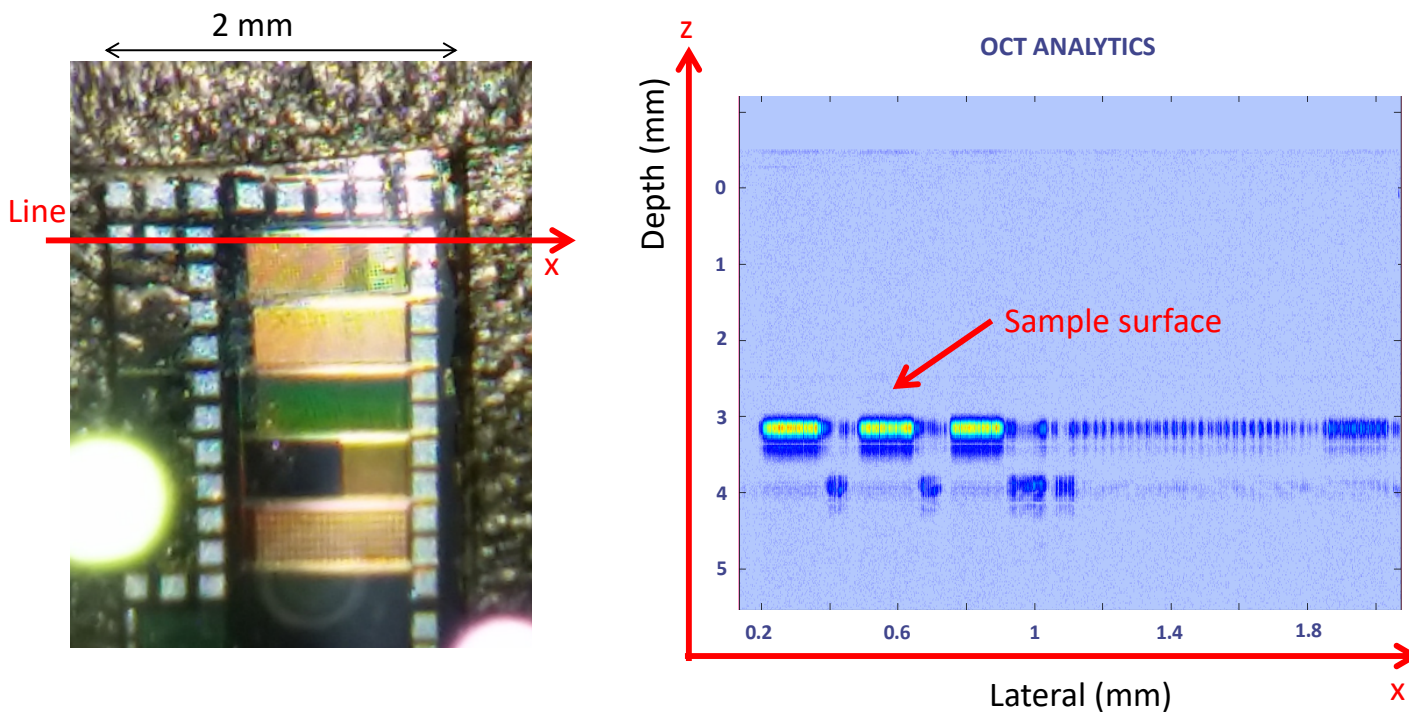




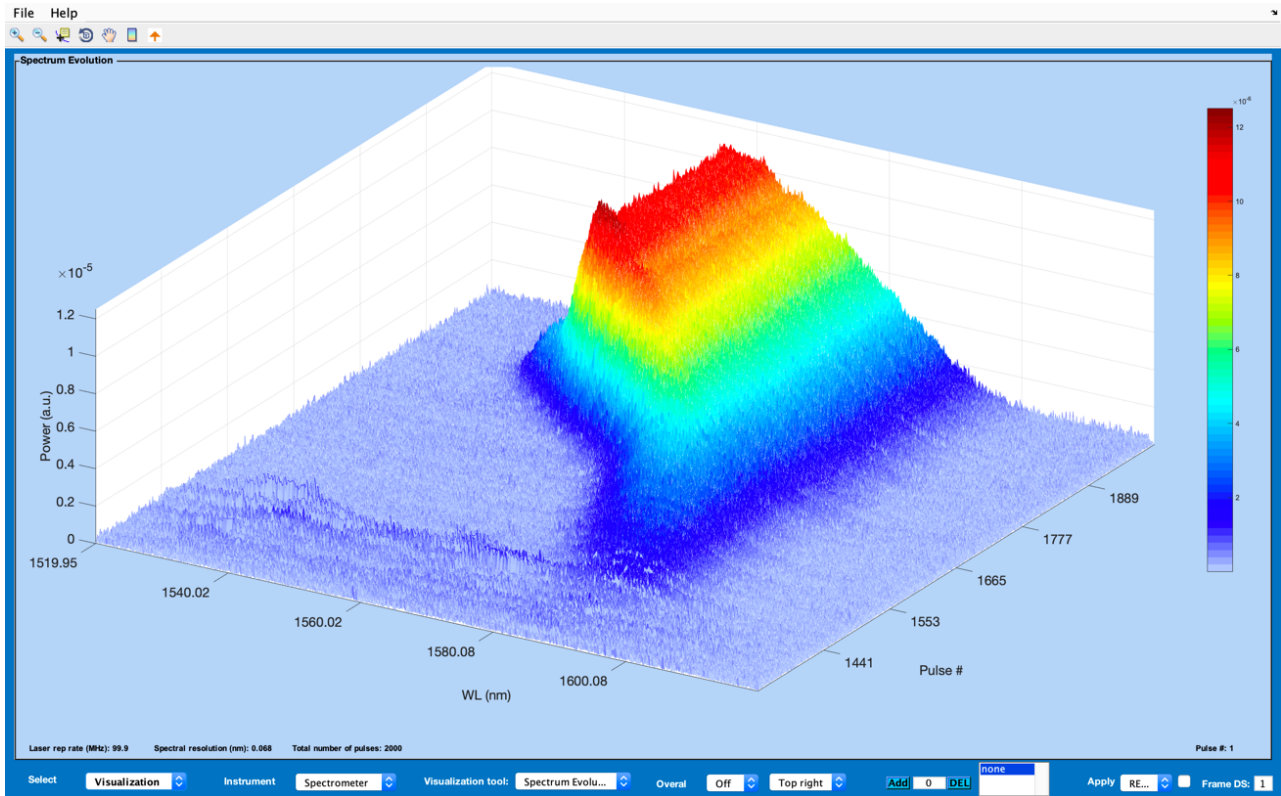
12-probe ultrafast imaging/vibrometry system enabled by single COMET spectrometer:  
 Transients of a 12-probe imaging system operated at 30 million frames/sec analyzed by COMET software.



Ultrafast Optical Coherence Tomography (OCT) imaging system enabled by COMET spectrometer: 720,000 single-shot consecutive line images at image acquisition speed of 36,000,000 lines per second.



**100 Million frames/second imaging of an air turbulence phenomenon enabled by COMET spectrometer.**



**COMET is showing effect of nonlinearity in an Optical Coherence Tomography (OCT) imaging system.**

