Dynamic Optical Frequency Analyzer– ChirpWise™

OFA-1000

Tunable lasers, especially swept-frequency (or swept-wavelength) lasers, are finding their way into many important applications, such as chirped Lidar for autonomous vehicles, optical coherence tomography (OCT) for biomedical applications, optical frequency domain reflectometers (OFDR) for distributed measurement and sensing, and tunable diode laser absorption spectroscopy (TDLAS). Unfortunately, the traditional optical spectrum analyzers (OSA) on the market are not capable of characterizing the dynamic properties of such lasers. The OFA-1000, a novel optical frequency analyzer specifically designed to fill this market void, is able to characterize dynamic spectral properties of tunable lasers, including instantaneous frequency, instantaneous spectral width, chirp or frequency tuning rate, frequency tuning nonlinearity, and optical power vs. frequency or time. Another important application of the instrument is to characterize the spectral properties of ultra long coherence length (or ultra-narrow linewidth) lasers, such as frequency jitter, center frequency statistical distribution, the dynamics of laser mode or frequency hopping, and the jitter induced spectral width of lasers, with a resolution down to tens of Hertz. Such capabilities are unattainable with traditional optical spectrum analyzers, but are invaluable to the scientific study of laser dynamics, as well as for interferometer based sensor systems such as hydrophones and distributed acoustic sensors (DAS). ChirpWise™: a wise instrument and a smart choice for analyzing laser chirp and other frequency dynamics.

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Preliminary Specifications[1]:

Optical Specifications	
Operating Wavelength Range	Dual Window 1260-1360 and 1480-1620 nm
Frequency Resolution (@3 dB)	User selectable; highest resolution 100 Hz
Spectral Finesse[2]	$\geq 10^9$
Wavelength Measurement Speed	User selectable, up to 10^7 nm/s
Wavelength/Spectral Accuracy	0.5 pm
Spectral Power Resolution	0.1 dB
Spectral Power Uncertainty	0.5 dB
Frequency Tuning Rate Accuracy, typical	±1 % typical
Spectral Width Accuracy	±5 % typical (Gaussian)
Frequency Chirp Accuracy	±5 % typical
Operating Power Range	−30 to +5 dBm
Optical Power Damage Threshold	500 mW
Data Acquisition Speed	Up to 1GS/s
Software (included)	ChirpView™
Electrical Specifications	
Power Supply	100-240 VAC, 50-60 Hz
Communication Interface	USB 3.0
Analog Output	0 to 4V max range, user configurable
Physical/Environmental Specifications	
Dimensions, Optical Module	5U 19" rack width
Operating Temperature	0 to 40°C
Storage Temperature	−20 to 60°C
Humidity	10-90% relative humidity

Notes:

1. Specifications are referenced to 25±5 °C.
2. Spectral finesse is defined as the spectral range divided by the spectral resolution.

Applications:

- Chirped LIDAR for Autonomous Vehicles
- Optical Coherence Tomography (OCT)
- Optical Frequency Domain Reflectometry (OFDR)
- Interferometer-based Sensor Systems
- Tunable Diode Laser Absorption Spectroscopy (TDLAS)

Unique Features:

- Characterize dynamic properties of tunable or swept lasers:
  - Instantaneous frequency
  - Instantaneous linewidth
  - Chirp
  - Frequency tuning nonlinearity
- Characterize spectral properties of narrow linewidth lasers:
  - Frequency jitter
  - Mode hopping
  - Jitter-induced spectral width

Ordering Information:

OFA – 1000 – XX

Connector Type:
FC/APC standard
FC/PC available

Typical Performance Data:

The following figures show measurements of tunable lasers modulated with periodic frequency modulation patterns. They illustrate the OFA-1000's ability to measure instantaneous laser frequency and power during wavelength modulation.

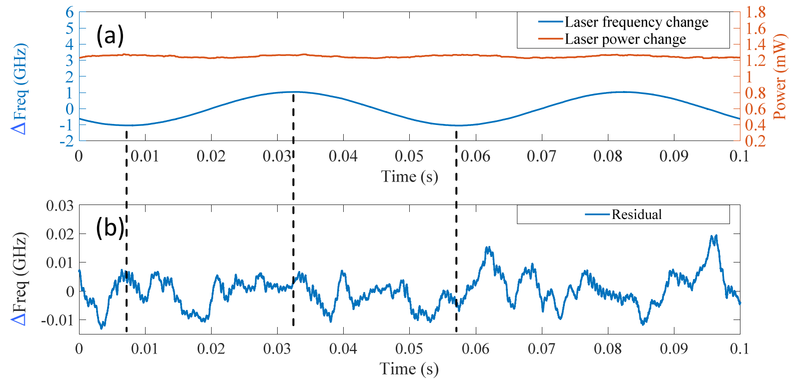

Figure 1 Sinusoidal laser frequency modulation
a) Laser frequency change and power vs. time
b) Deviation from sinusoidal waveform

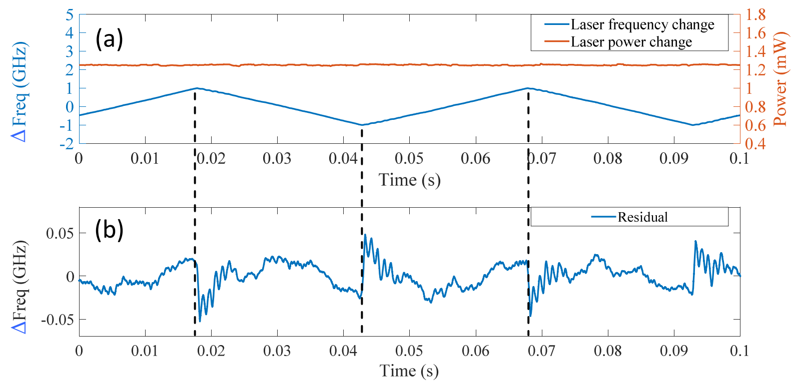

Figure 2 Triangular laser frequency modulation
a) Laser frequency change and power vs. time
b) Deviation from triangle waveform

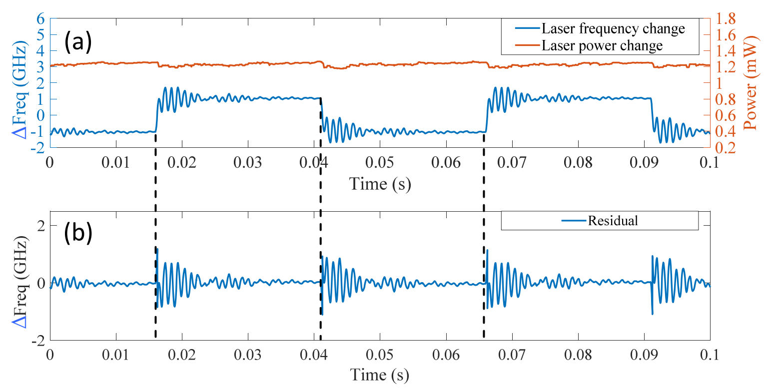

Figure 3 Square wave laser frequency modulation
a) Laser frequency change and power vs. time
b) Deviation from square waveform

The following figures show measurements of tunable lasers modulated with arbitrary frequency modulation patterns.

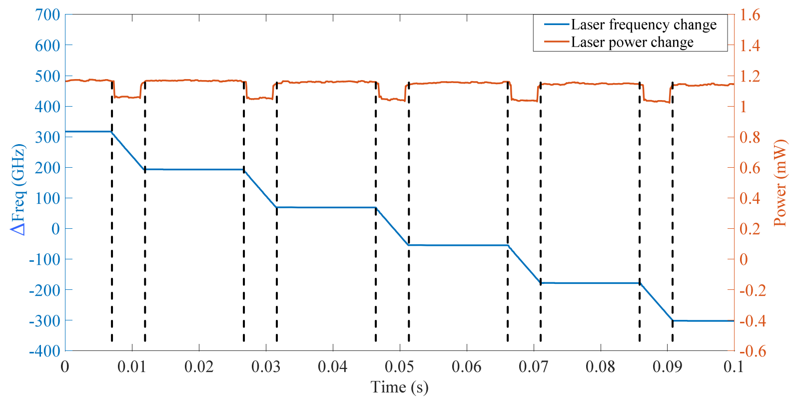

Figure 4 Step-modulated laser (v=10nm/s , dλ=1nm)

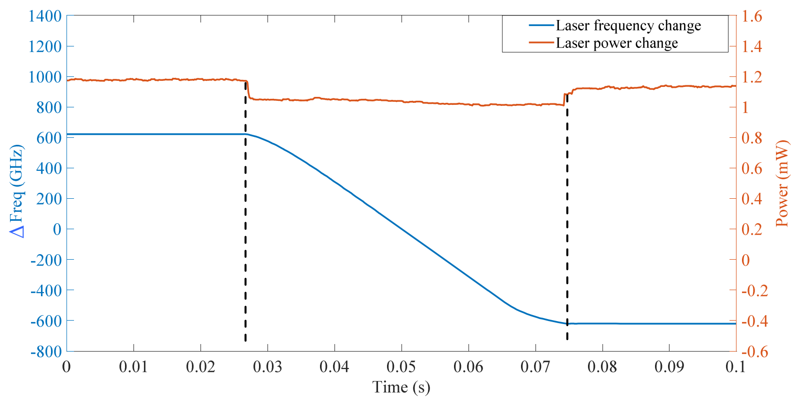

Figure 5 Continuously modulated laser (v=50nm/s , dλ=10nm)

The following figures show laser transient (jitter) behavior at nominally static frequency settings for different types of lasers. It is evident that the tested lasers show very different behavior in terms of both the total amount of jitter and the frequency distribution.

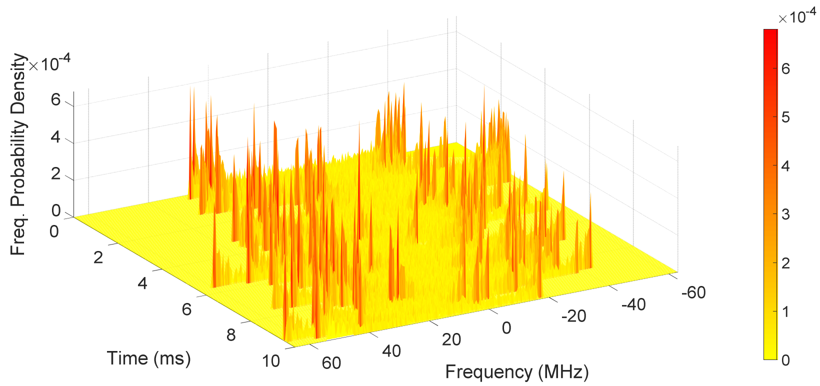

Figure 6 Yenista tunable laser at static frequency setting

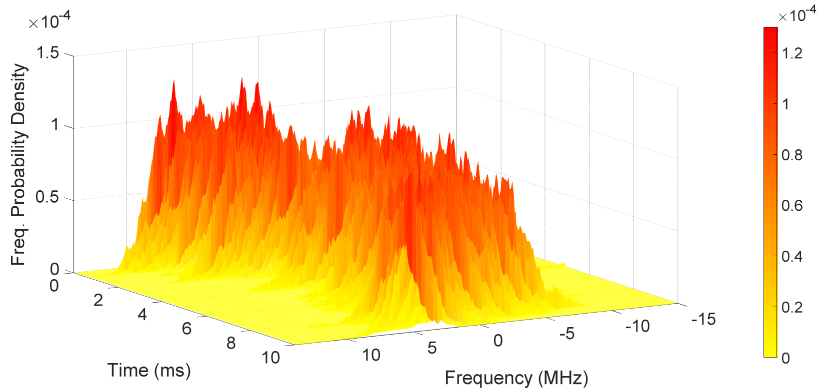

Figure 7 APEX spectrometer built-in laser

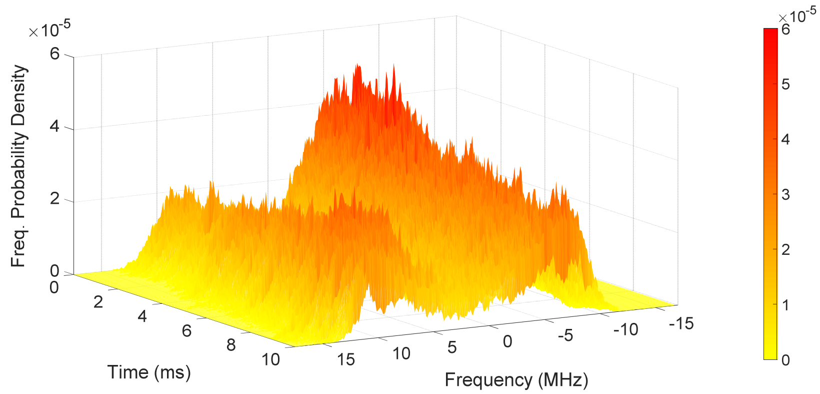

Figure 8 DFB laser

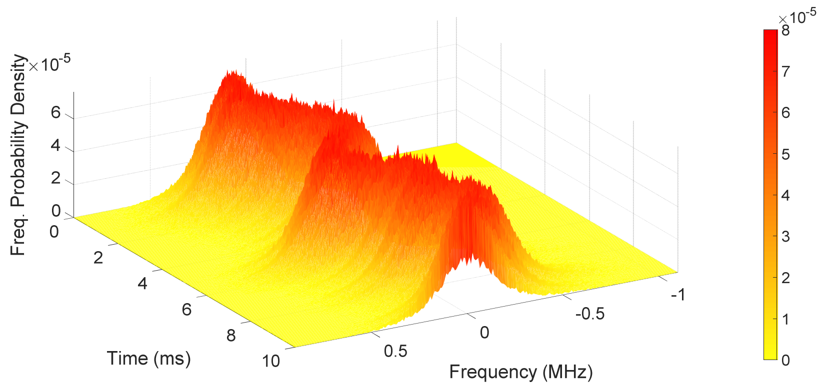

Figure 9 Composite cavity laser