Multispectral Laser with Improved Time Division Multiplexing

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WARF: P07511US

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing an improved multi-wavelength, time-division multiplexed laser.

Overview

Multi-wavelength fiber lasers provide cost-effective and versatile light sources for applications including high-speed optical communication systems, optical fiber sensors and time- and frequency-resolved spectroscopy. A UW-Madison researcher previously developed a multi-wavelength, frequency-division multiplexed (FDM) laser. That laser produces multiple, discrete wavelengths by using a laser cavity with a different effective optical length at each wavelength. The desired wavelengths are selected by briefly switching on an optical amplifier to boost those cavity modes compatible with the chosen wavelengths. However, the laser is limited by gain competition between different frequencies in the amplifier, which can cause power fluctuations, and requires a Fourier transformation to extract time data.

The Invention

UW-Madison researchers now have developed an improved, multi-wavelength, time-division multiplexed (TDM) laser capable of individually controlling multiple narrow wavelengths in separate time-division windows. Unlike the previous laser, this device uses a cavity that provides the same cavity length for each wavelength. To separate light into multiple wavelengths, it introduces a fixed time shift in the arrival of each wavelength at the output coupler as a function of the wavelength. It continuously cycles through the spectrally narrow wavelengths, spending a predetermined amount of time on each one. Specifically, the laser cavity holds the optical amplifier between a wavelength-dependent delay element (WDE) that temporally separates a multi-wavelength light pulse into discrete constituent monochromatic components, and a complementary wavelength-dependent delay element (CWDE) that temporally collects the monochromatic components after separation. This design reduces gain competition, simplifies the circuitry for controlling the amplifier and distinguishing the output pulses, and improves the consistency and control of the multiple monochromatic wavelengths.

Applications

- High-speed optical communications
- Optical fiber sensors
- Time- and frequency-resolved spectroscopy

Key Benefits

- Simple and rugged design
- Enables cost-effective and versatile optical sensors
- Capable of stable operation at tunable and lockable wavelengths
- Includes a method for tagging each wavelength so a single, multiplexed beam measured by a detector can produce a signal for each of the composite wavelengths

- Does not require the use of a Fourier transformation to extract time from frequency data
- Laser cavity is designed to reduce gain competition between different wavelengths, increasing the stability of the laser.
- Crosstalk minimization in the amplifier promotes the low noise and stability required for sensor applications
- All-fiber source contains no moving parts, offers high repetition rates and a custom gain for each wavelength.

Additional Information

For More Information About the Inventors

- Scott Sanders

Related Technologies

- See WARF reference number P07171US for the inventor's multi-wavelength, frequency-division multiplexed (FDM) laser.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Lasers
- Analytical Instrumentation, Methods & Materials : Optics
- Analytical Instrumentation, Methods & Materials : Spectroscopy

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867