iScan – a Tool for Active Detuning Control of a Diode Laser

The iScan provides a versatile tool for wavelength stepping and wavelength locking of tunable diode lasers. In addition, it can be used to linearize wavelength scans, as well as for mode monitoring of diode lasers. The device is based on a patented interferometric set-up that generates computer-readable quadrature signals, which are used in a feed-back loop. A sophisticated microcontroller assembly allows flexible usage in all applications of tunable laser sources.

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Key Words

Laser stabilization, detuning control, iScan, interferometric control, quadrature detection, scan linearization, wavelength stepping, wavelength locking

Related Products

TOPTICA Photonics AG DL 100
TOPTICA Photonics AG iScan

1 Description

In demanding scientific or industrial applications – laser interferometry, spectroscopy, telecommunication, tunable laser development – one often needs to detune the laser wavelength in precisely defined steps.

TOPTICA's iScan technology was developed to accurately control and monitor wavelength detuning of diode lasers. The iScan uses a patented optical interferometer design: Upon detuning of the laser wavelength, two photo diodes *a* and *b* detect an oscillating signal with a phase difference of $\lambda/4$. The quadrature signals are fed back into an active control loop driven by a microprocessor assembly. For specific applications, multidimensional parameter sets can be stored and retrieved for subsequent analysis.

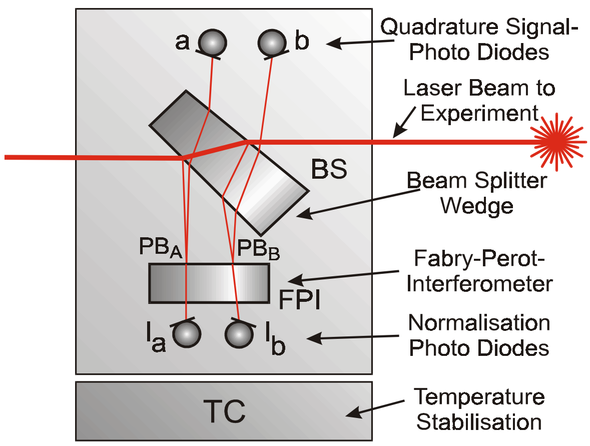

Figure 1 Interferometer Setup

The interferometer setup of the iScan is shown in Figure 1.

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A beam splitter wedge generates two probe beams PB_A, PB_B. A Fabry-Perot etalon causes interference within each probe beam. The reflected beams pass the wedge again and acquire a relative phase difference of $\lambda/4$. When the laser wavelength shifts, the photo diodes *a* and *b* detect oscillating signals with a phase difference of 90°. The Photo detectors I_a and I_b serve for normalization.

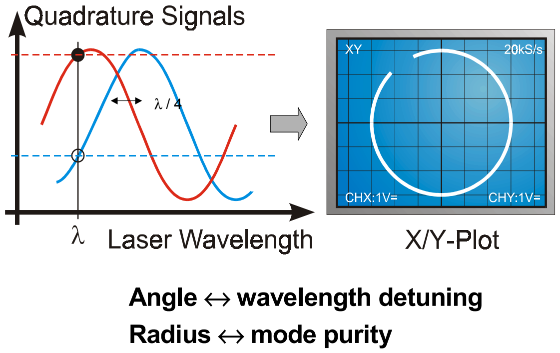

Figure 2 Quadrature signals. An xy-display on an oscilloscope yields a circle (right).

The iScan features a microprocessor unit for intelligent surveillance and control of the tunable laser. More dimensional parameter (e.g. mode charts of a laser) sets can be stored and retrieved for subsequent analysis. A remote control unit (RCU) enables the user to conveniently access all relevant parameters. Alternatively, the iScan system can be controlled by a PC, using the provided RS 232 interface.
The iScan is a versatile instrument that can be used for scan generation or linearization, wavelength stepping and wavelength locking, laser detuning control, laser mode monitoring and active compensation of vibrations.

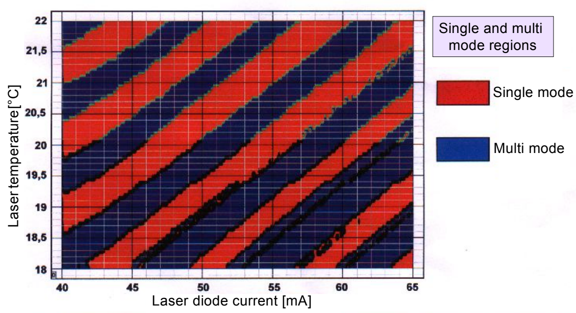

Figure 4 Example of a mode chart of a diode laser. The iScan was used to determine single mode regions (red) and multi mode regions (blue) in dependence on the laser current and the operating temperature.

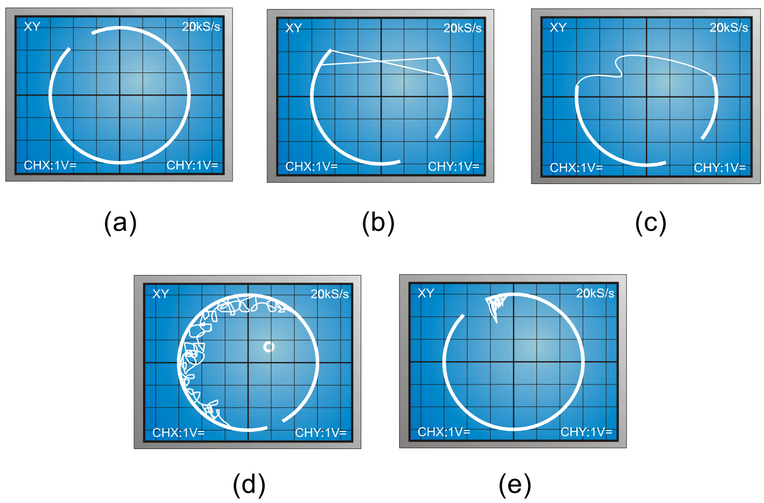

Figure 3 Oscilloscope traces.
(a) Single mode scan.
(b) Mode hop in the middle of the scan range.
(c) Scan with a multi mode situation.
(d) Mode instability by optical feed-back.
(e) Mode instability at end of the scan.

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