All-electronic wavelength control

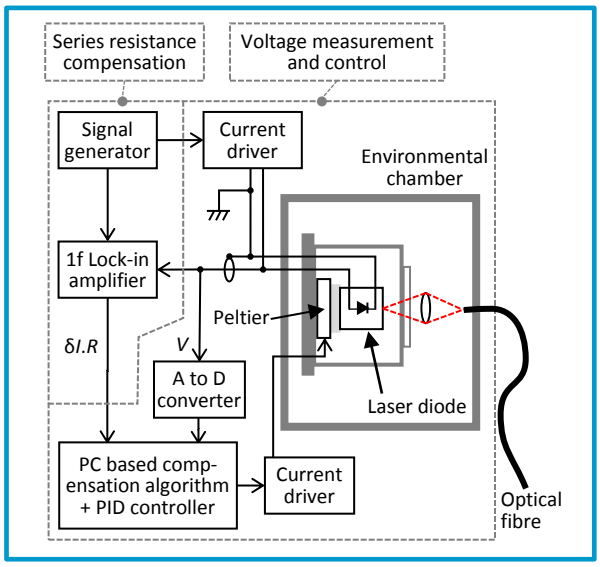
Wavelength control of semiconductor lasers and LEDs

- Stringent performance requirements exist in telecoms, gas sensing and optical fibre sensing.
- Wavelength varies with temperature and current; the biggest challenge is to measure temperature of the active region itself with high precision.
- Control uses measurement of junction voltage, which is a sensitive measure of junction temperature.
- This delivers precise wavelength control when the external (case) temperature varies.

Our approach

- Previous measurements of junction voltage have been hampered by device series resistance, which itself changes with temperature.
- Our innovation is to measure the series resistance in real time and thereby provide an accurate measurement of junction voltage.
- We apply a small current modulation δI and measure the modulated voltage δV, giving resistance as δV/δI.
- Work to further reduce the applied modulation is ongoing.

Implementation



Implementation is electronic and requires no additional optics or physical alignment.

In principle, the system is retro-fittable, wavelength – independent and can be applied to many types of semiconductor lasers and LEDs.

Recent performance results for a 1580nm telecoms laser:

Wavelength stability (centre wavelength of modulation)	± 2.5 pm, 300 MHz
Range of case temperatures tested	20 - 40 °C
Wavelength deviation	8.3 pm,1000 MHz

Further information:

[1] A Asmari, J Hodgkinson, E Chehura, S E Staines and R P Tatam, “All-electronic frequency stabilization of a DFB laser diode”, *Optics Express*, **25**, pp. 11679-11691, 2017.

[2] A Asmari, J Hodgkinson and R P Tatam, “Wavelength Control of Laser Diodes”, UK Patent application no. GB1406664.1, 2014.

Centre for Engineering Photonics

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About Cranfield University

Cranfield is an exclusively postgraduate university that is a global leader for transformational research in technology. Cranfield is focussed on the specialist themes of aerospace, defence and security, energy and power, environment and agrifood, manufacturing, transport systems, and water.

Cranfield has the largest number of engineering and technology postgraduates in the UK, awards over five percent of the UK's engineering and technology PhDs each year and currently works with over 1,500 companies and organisations worldwide.

Cranfield is ranked in the top five of UK universities for commercial research income, with 81% of Cranfield's research classed as world-leading or internationally excellent by REF (Research Excellence Framework, 2014). Cranfield University was formed in 1946 as the College of Aeronautics, the first postgraduate college of its kind.

The Centre for Engineering Photonics

Engineering Photonics at Cranfield is recognised internationally as a leading centre for optical sensing and instrumentation, which, since its inception in 1989, has been led by Professor Ralph Tatam. Engineering Photonics undertakes research ranging from blue skies concepts to the development of prototype instrumentation that is used by us and our academic and industrial collaborators in real environments. Further information about the Centre and a full list of publications and links can be found at openoptics.info.

Research areas

Engineering Photonics applies advanced photonic technologies to solve challenging measurement problems. Our research underpins measurements across a wide range of industrially important areas such as: aerospace, healthcare, manufacturing, transport, automotive, environment and agrifoods. We work in collaboration with academia, SMEs and major international companies both nationally and internationally.

Technologies

Optical interferometry; optical fibre sensor technology including interferometry, FBGs and LPGs; optical imaging and image processing; optical gas sensing; speckle interferometry and metrology.

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