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Improvement of calibration accuracy in fibre optic wavelength for DWDM applications

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Abstract content
   (Max 300 words)

Accurate wavelength measurement is of great importance in optical fibre networks, particularly due to the architectures such as dense wavelength division multiplexing (DWDM). DWDM allows different 'channels' (or data streams) to be transmitted simultaneously along the same fibre, with each channel occurring at a specific wavelength. As the number of channels increases, so the channel spacing (or wavelength 'gap') decreases between consecutive data-carrying streams. This allows for a single fibre to transmit vastly greater amounts of data – thus improving network capacity. For DWDM applications, in particular, the range of optical communications wavelengths for which the highest accuracies are required is that between 1460 nm and 1625 nm.

NMISA's Fibre Optics Laboratory relies on an optical spectrum analyser (OSA) to measure optical power as a function of wavelength. Traceability for optical wavelength used to be derived solely from the absorption spectrum of an acetylene-filled reference cell built into the OSA. However, acetylene's near-infrared rotational vibrational absorption spectrum ends just beyond 1540 nm. This meant that, in the past, fibre optic wavelength could not be measured with an accuracy that is small enough to distinguish between consecutive DWDM channels in the most important wavelength regions: near 1550 nm and 1620 nm.

This paper details the improvements made at NMISA in the accuracy of measuring fibre optic wavelengths in the near-infrared. These improvements have been achieved as the result of using an external gas reference cell containing hydrogen cyanide (HCN) and carbon monoxide (CO). The absorption spectra of these gases are centred at 1534 nm and 1610 nm, respectively. This has allowed measurements to be made at accuracies of less than 0,2 nm near these wavelengths – as is necessary for DWDM applications. Comparisons between measured and modelled absorption spectra show the practical implications involved in providing traceability for fibre optic wavelength based on gas reference cells.

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