Performance comparison between Raman and Brillouin intensity based sub metre spatial resolution temperature compensated distributed strain sensor

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With the capability of Brillouin Optical Correlation Domain Analysis (BOCDA) technique to probe measurands with millimeter order spatial resolution [1], the idea of combining intensity measurements with BOCDA for high spatial resolution temperature compensated distributed strain sensing has been explored and successfully demonstrated [2, 3]. This paper discusses the advantages of achieving this temperature compensation using Raman [2] or Brillouin intensity measurements [3]. Fig. 1 shows a summary of temperature compensation strain measurements made using Raman/Brillouin intensity in combination with Brillouin frequency based BOCDA. The 131m long sensing fibre comprised a 42m unheated-unstrained section, 14.5m of unstrained section maintained at 52°C, 33m unheated-unstrained section, 3.5m unheated section subject to 1044 με over a fibre strain rig and 38m unheated-unstrained section of standard single mode telecommunications fibre.

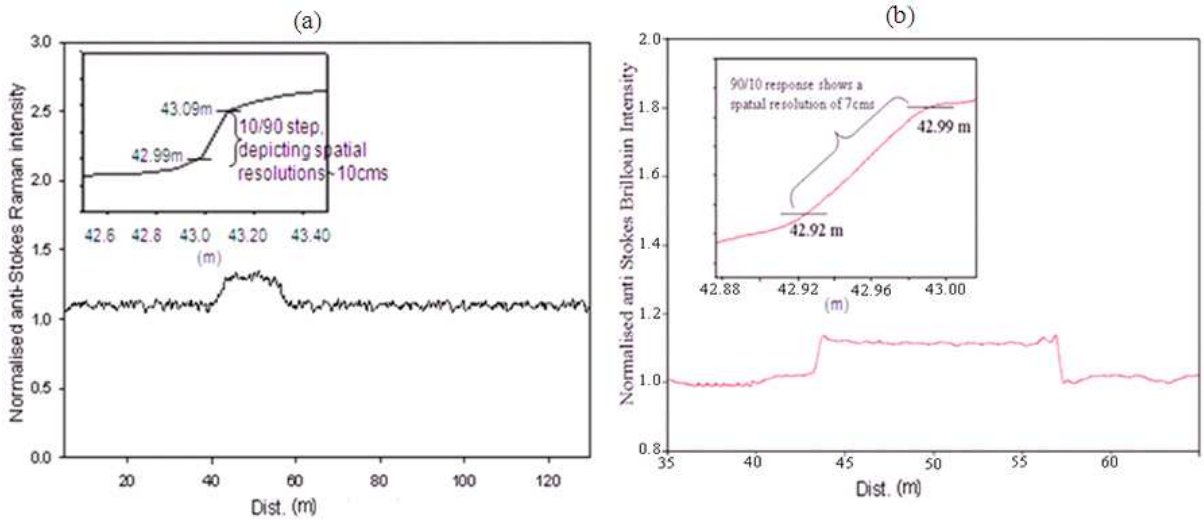

Fig. 1. (a)Shows the normalised R-OTDR plot of fibre in section 2 heated to 52°C with the inserts depicting a 100 point running median of the normalized Raman anti Stokes data with spatial resolution of 10cms; fig. 1 (b) shows 10/90 % step of the normalised Brillouin anti Stokes data depicting a spatial resolution of 7cms .

Combining the error of Brillouin frequency (BOCDA~1.7MHz) measurements with the error of the Raman intensity (ROTDR~1.56%, fig. 1(a)), a temperature corrected strain of 94 με was achieved. However, the combination of the Brillouin frequency error (BOCDA~1.7MHz) with error of the Brillouin intensity (BOTDR~0.34%, fig.1(b)) measurements, yielded à temperature corrected strain of 56 με. Furthermore, the spatial resolution achieved using Brillouin intensity measurement was 7cms as compared to 10cms obtained using the Raman intensity measurement. Both of these results, i.e., of temperature corrected strain value and spatial resolution, demonstrate the advantage of using backscattered Brillouin power over backscattered Raman power, for short sensing range.

In conclusion, combining BOCDA with measurement of the backscattered Brillouin anti Stokes signal provides improved high spatial resolution temperature corrected distributed strain measurements.

References

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