# AN ASSESSMENT OF THE SPATIAL-FILTERING TECHNIQUE FOR THE MEASUREMENT OF REFRACTIVE-INDEX PROFILES IN OPTICAL FIBRE PREFORMS

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The performance of optical transmission systems is strongly dependent on the details of the fibre refractive-index profile. In previous papers[1,2] we have shown that non-destructive measurements performed on both single-mode and multimode fibre preforms by a spatial filtering technique can reveal the index profile with remarkable accuracy and resolution. The method involves imaging of the transversly-illuminated preform by means of a high-quality lens and modulating the transmitted light in the lens focal plane with any of a number of types of spatial filter. With the aid of a small photodetector placed in the image plane it is possible to isolate individual rays in turn and to determine their deflection as they traverse the preform. The index profile is reconstructed from this deflection data by performing an integral transform.

In this paper we present an assessment of the accuracy and spatial resolution of the preform profiling technique when used as a routine measure of fibre quality. A number of factors affecting the measurement precision have been identified by performing a series of experiments on different preforms. It is shown that, contrary to expectations, the collimation of the illuminating beam is not of critical importance. Fourier analysis of the spatial frequency content of the deflection profile shows, however, that the detector size and the lens numerical aperture and quality are the critical factors. Furthermore, significant ellipticity in the preform can cause an error in the computed profile owing to the mathematical assumption of circular symmetry.

Methods whereby the effect can be minimised are outlined.

As a result of the study, a number of improvements have been implemented which have increased the accuracy and resolution of the spatial-filtering technique.

Results are presented which demonstrate the ability of the method to predict single-mode fibre cut-off wavelength and multimode fibre parameters from preform data. A major advantage is that the measurements can be performed nondestructively along the length and variations in profile observed. Moreover, the technique is applicable to fibres and preliminary results are presented of index profiles obtained directly from the fibre.

References

1. I. Sasaki, D. N. Payne and M. J. Adams, Electronics Letters, 16, (1980), pp. 219-221.

2. I. Sasaki, D. N. Payne, R. J. Mansfield and M. J. Adams, Proc. ECOC 6 (York, 1980), pp. 140-143.