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

I. SASAKI AND D. N. PAYNE

DEPARTMENT OF ELECTRONICS, UNIVERSITY OF SOUTHAMPTON, 
HAMPSHIRE, SO9 5NH

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 transversely-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
