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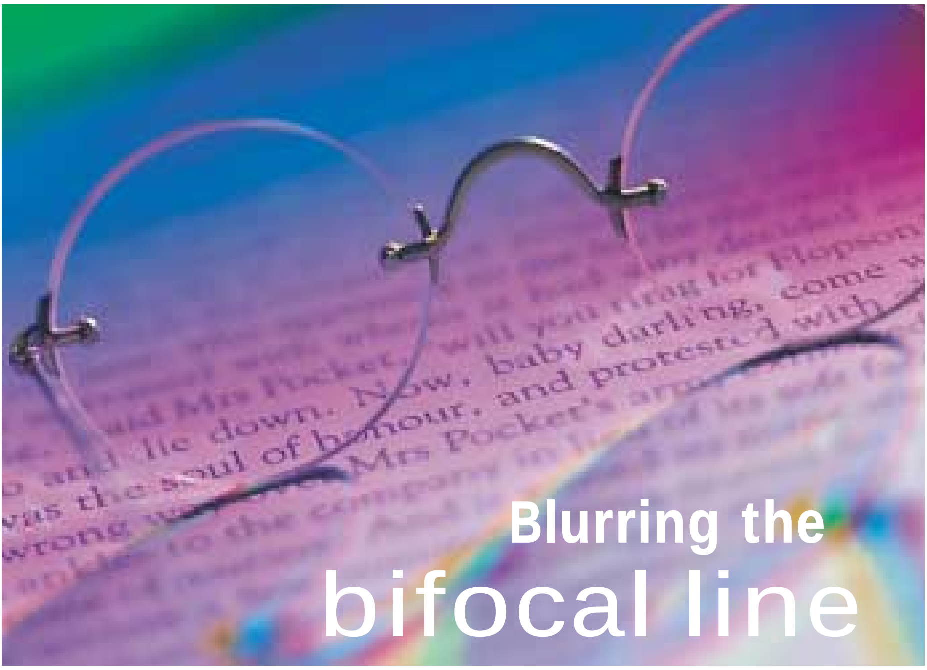

Blurring the bifocal line

Mathematical tools developed by Dr Tony Miller of CSIRO Mathematical and Information Sciences are playing a key role in bringing better vision to millions of people worldwide.

Miller's mathematics have enabled spectacle lens company, SOLA International, to develop of a range of 'progressive' lenses for sufferers of presbyopia, the age-related loss of ability to focus at short distances.

The problem is commonly corrected using bifocal lenses, which have distinct zones for distance and close up vision. Progressive lenses offer wearers the same overall correction, without the visual discomfort caused by the dividing line.

'Bifocal lenses basically consist of two differently curved lenses joined together. So when people look downwards and make the transition from the distance vision part of the lens to the near vision part, there's a sudden change in magnification and the image tends to jump,' Miller says.

'But progressive lenses provide a gradual transition between the two visual zones, and move any blur and distortion towards the peripheral part of the lens where they are less of a problem for the wearer.'

Miller says these achievements arise from advances in mathematical ways of describing the lens surface and a better understanding of wearers' perceptions of blur and distortion.

'Creating a progressive lens is a bit like attempting the impossible because it involves combining two or more different lenses, each with a different shape, and trying to get a seamless transition from one shape to the next,' he says.

'But partial derivatives and other mathematical concepts are an ideal way of thinking about this problem, as they can precisely describe the subtle shapes involved in lens design. Over the years we have also found ways to better quantify what people perceive as blur and distortion, allowing us to minimise these properties during the design process.'

Miller says the first step in the design process is to describe the lens surface in mathematical terms. A formula is then use to calculate blur at each point on the lens surface and produce a 'blur map' of the lens. A similar process is used to map distortion.

Scientists can then optimise this mathematical model of the lens until the blur and distortion recede to the lens periphery. When the optimal shape is achieved, the shape information is fed into various computer controlled manufacturing processes, which generate moulds from which the finished lens is cast.

Miller received the Sir Ian McLennan Achievement for Industry Award, in recognition of his contribution to the development of an Australian industry. For 14 years his work with Adelaide company, SOLA Optical, now a division of SOLA International, has provided the mathematical tools necessary for continued improvements in spectacle lens design.

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