Spatial frequency filters for imaging fibre characterisation

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1. Proteus will use an imaging fibre to image inside the distal lung. An imaging fibre is formed of closely packed light guiding cores, surrounded by a common cladding. Methods of quantitatively comparing imaging fibres are needed to later fabricate better designs.

2. Cores of an imaging fibre sample an image. Closer cores can sample this image better, but light can also spread more easily to neighbours. The separation of cores must be close enough to sample the image, but far away enough to minimise the coupling of light to neighbouring cores.

3. Imaging fibre performance needs to be characterized. Imaging resolution can be tested with a USAF target, which is a series of line pairs at different scales. The smallest line pairs that can be imaged will determine the resolution. We developed a interferometric based method to generate a continuous series of fringes across the fibre face in order to quantitatively characterize the imaging fibres. In both cases, the fringes represent a specific point in the range of spatial frequencies that the fibre can image.

4. Random spatial frequency filters can quantify imaging fibre resolution. White noise is a random signal that has equal intensities at different frequencies. It has a flat power density spectrum. The 2D fourier transform through an imaging fibre of white noise would be clipped because the imaging fibre can only give low spatial frequencies. This tells us the limits of the resolving power of the fibre. We have fabricated a mask in order to experimentally represent this.

5. Conclusions: In order to quantitatively compare imaging capabilities of our fabricated imaging fibres, we have developed an interferometry technique that can characterize fibres across their whole field of view. Further characterization can be achieved with specialty masks, fabricated at Bath, in order to better assess the full resolution of our imaging fibres.

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