to turn to other material platforms that provide a higher refractive index contrast and thus smaller waveguides, such as SOI. Yet, even in this case, a complex 2D mesh will require strict control of waveguide uniformity and roughness along the whole structure to guarantee homogeneous performance.

Another challenge relates to power consumption and heat dissipation. The researchers report that the average power consumption per MZI tuning heater is 0.25 W, which is high for an individual cell if the design is going to be scaled to a much larger number of cells. Furthermore, because tuning in Si_3N_4 is based on the thermo-optic effect, it mandates careful control of chip temperature and optimized designs of waveguides and heaters, which may increase the device size. Solutions to this limitation may be achieved by resorting to other platforms featuring electro-optic tuning.

The possibility of developing a universal MWP signal processor is becoming a popular area of research, not only because of the advantages in fabrication costs outlined before, but also because it points to the tantalizing prospect of software-defined MWP. In this sense, the work reported by Zhuang and colleagues is an important development, but it is not the only approach that is being tried and worth exploring.

In particular, Guan and co-workers[8] reported an optical lattice filter based on cascading CMOS-compatible silicon unit cells, each one employing a combination of a ring resonator and a MZI with tunable phase elements in both arms of the inteferometer (see Fig. 2a inset). Also, Wang *et al.*[9] reported a design based on cascading ring resonator stages that demonstrated programmable pulse shaping. Finally, a third alternative involves the design of the optical core using the self-configuring universal linear optical components recently reported by Miller[10]. ❐

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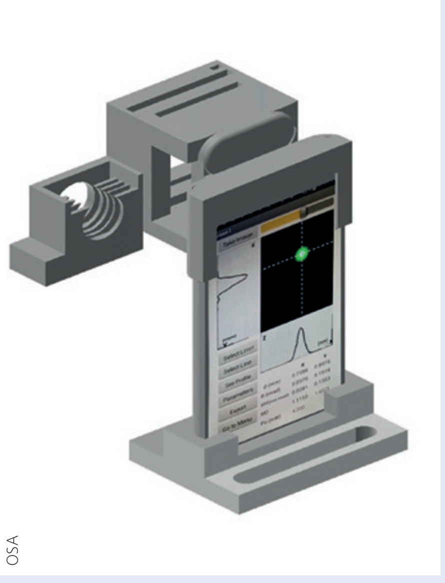
IMAGING AND SENSING

Portable profiler

Md Arafat Hossain and colleagues from the University of Sydney have developed a smartphone-based ultraviolet laser beam spatial profiler (*Opt. Lett.* **40,** 5156–5159; 2015). Their device, which is low cost thanks to the use of three-dimensional mount printing and the competitive pricing of mobile phone technology, is able to measure a laser beam's spatial profile, output power, divergence and beam quality factor, with all information displayed on the phone's screen and optionally transferred conveniently via the internet.

In their set-up, the ultraviolet beam strikes a 4 cm × 4 cm phosphor glass plate that is normal to the beam's propagation direction. The phosphor plate downconverts the ultraviolet light to visible wavelengths, which is imaged onto the phone's CMOS camera, located 3 cm downstream, via an external lens (thickness, 10 mm; focal length, 10 mm). The phone used is a Kogan 4G, which has an 8 MP rear-facing camera with a maximum signal-to-noise ratio of around 55 dB. Neutral density filters (or other suitable attenuators) are used to avoid saturation of the CMOS sensor. The software to display the beam and its parameters runs on the phone itself. The team evaluated the performance of the scheme by characterizing two ultraviolet



OSA

lasers: a continuous-wave Ar^+ laser (244 nm wavelength) and a pulsed ArF laser (193 nm wavelength, 30 Hz repetition rate, 15 ns pulse duration). Experimental variation in the measurements was comparable to commercial beam profilers.

John Canning, corresponding author for the manuscript, told *Nature Photonics* that the idea worked surprisingly well, and that the main challenge was to ensure measurements could be made both rapidly and reliably. The current system employs a phone running an Android operating system. Canning explained that the Android user-base is several times larger than that of Apple's iOS phones, and that the Android platform may have programming advantages. However, he notes that the same device could be achieved on an iOS system.

"We have already demonstrated combined spectrometer instrumentation with both absorption and fluorescence, so the next direction will be combining multiple instruments onto a single platform," Canning remarked. "For this particular example, adding spectroscopy and linewidth measurements for lasers is potentially feasible. [...] It is also possible to combine laser characterization during spectroscopic analysis so that the beam profile is always understood during excitation of the source being studied."

In their manuscript, the researchers explain that the detection range could be extended to, for example, the near-infrared regime. Canning also noted that the instrument could be made smaller to accommodate other capabilities. There are plans to commercialize some of the team's smartphone instrumentations.

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