Spectrum Reconstruction Through Machine Learning

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Abstract

Standard optical spectrometers rely on gratings and long light paths, and as a result tend to be bulky equipments suitable only for laboratory work. Yet there is a whole range of potential applications that spectrometers could have (e.g. counterfeit detection, determining fat or sugar content in food products, the pharmaceutical industry, in health monitoring, etc) if only they could be miniaturised enough as to make them portable or wearable. Furthermore there is a wealth of possible industrial applications where weight or size impose severe constraints, such as in the space/satellite or drone industries. This potential has fuelled a great interest in spectrometer miniaturisation in recent years, with many miniaturisation strategies discussed in the literature [1]. Invariably these strategies involve translating the optical spectrum into a different kind of signal (e.g. an electrical current) from which the sought spectrum can be reconstructed. The latter step can be most effectively carried out using **Machine Learning** techniques. In this presentation we describe our own efforts to construct miniaturised optical spectrometers [2], which exploit strain-engineered photodetectors based on 2D semiconductors. Our discussion focuses on the spectral reconstruction process, which is key to the success of any miniaturised spectrometer design.

References

1. Z. Yang, T. Albrow-Owen, W. Cai and T. Hasan, Science **371** (2021) 681.
2. T. Vasconcelos *et al.*, in preparation.

Figures

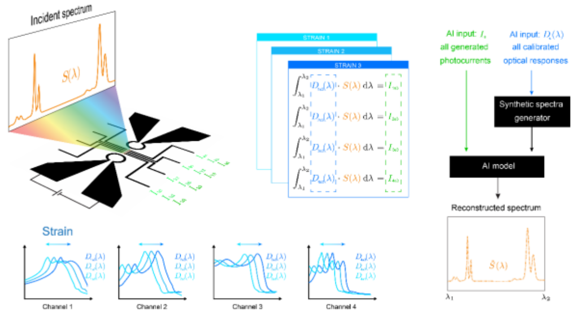

Figure 1. Schematic reconstruction process. Spectral responsivities D are experimentally characterised as a function of both wavelength and strain state.