Human-Inspired Autonomous Optical System Alignment

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High-precision alignment during the manufacture of optical and laser systems is essential to ensure system performance for a vast range of applications across both industry and academia. These processes are time-intensive and require experienced personnel, particularly as the optical and laser systems increase in complexity. Increased complexity of the optical system can manifest as an increased number of potential adjustments, measurements and/or components. This, along with difficulties such as system noise and hysteresis, can often inhibit the intuition of the human operator, resulting in expensive and time-consuming alignment processes. There is considerable interest in the use of automation (including machine learning) to develop autonomous optical system alignment and assembly, which has seen limited deployment to date in the optics industry.

There are many methods gaining traction in automation science that are potentially applicable to optical systems, particularly in the approach to Industry 5.0. However, with an ever-increasing number of potential machine learning algorithms to apply, an ongoing issue across many fields is determining the ideal techniques to realise this potential.

Our approach to this issue involves integrating human behaviour studies to understand current expert practice in aligning representative optical systems. We then use this information to inform, and modify, our choice of automation strategy to produce “human-inspired” approaches which can then be deployed across a range of industrially and academically relevant systems.