Physical Sciences Seminar

Rise of the Machines: Making better photons by getting rid of experimentalists

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There is now an enormous opportunity to interconnect quantum components together into complex, short- and long- range networks of sensing, communication, and computational elements. Photons are a natural choice for networking quantum technologies as their quantum nature survives at room temperature and long distance propagation is possible, either via optical fibre or through free space.Here we explore using machine learning (ML) to optimise production, coupling, routing, and circuitry for single photons. Our single-photon source platform is resonant excitation of individual quantum dots coupled to a micropillar cavity. Multiphoton suppression in the quantum dot emissionas well as single-photon indistinguishability and brightnessare directly influenced by the spatiotemporal characteristics of the optical excitation pulses. We use ML techniques to tailor the excitation laser pulse properties in real-time, significantly reducing the search time for optimal parameters. We also employ ML to control a deformable mirror, correcting for aberration on the single-photon wavefront field to maximise the coupling between the source output and a single-mode fibre. This combination provides a toolbox for enhancing the performance of any solid-state single-photon source.Photonic integrated circuits (PICS) will be essential for scalaby realising photonic quantum technologies. Actively coupling photons into PICS requires high-fidelity integrated switches. Current best practicemanual optimisation of electronic signals for each individual switch on a chipis slow and unscalable. We use MLsimulated annealingto optimise driving parameters for up to 4 switches on a single chip, achieving a significant speed up in tuning while retaining optimal performance. PICS often interface light in and out of the chip using edge coupling, which severely limits chip geometry as well as adding complication to fabrication. Using MLinverse designwe are developing efficient out-of-plane couplers and small-footprint waveguide crossings that are easier to manufacture and have higher circuit density. This new architecture lowers entry costs for photonic integrated circuitry development.

Friday, July 8, 2022 10:00am - 11:00am
Mondi Seminar Room 2, Central Building

This invitation is valid as a ticket for the ISTA Shuttle from and to Heiligenstadt Station. Please find a schedule of the ISTA Shuttle on our webpage: https://ista.ac.at/en/campus/how-to-get-here/ The ISTA Shuttle bus is marked ISTA Shuttle (#142) and has the Institute Logo printed on the side.