Keynote 3	From inverse design to implementation of robust and efficient photonics for computing
Speaker	**Jelena Vuckovic** *Stanford University, US*

Abstract

It is estimated that nearly 10% of the world electricity is consumed in information processing and computing, including data centers [D.A.B. Miller, Journal of Lightwave Technology, 2017]. It is clear that the exponential growth in use of these technologies is not sustainable unless dramatic changes are made to computing hardware, in order to increase its speed and energy efficiency. Optical interconnects are considered a solution to these obstacles, with potential to reduce energy consumption in on-chip optical interconnects to atto-Joule per bit (aJ/bit), while increasing operating speed beyond 20GHz. However, the state of the art photonics is bulky, inefficient, sensitive to environment, lossy, and its performance is severely degraded in real-world environment as opposed to ideal laboratory conditions, which has prevented from using it in many practical applications, including interconnects. Therefore, it is clear that new approaches for implementing photonics are crucial.

We have recently developed a computational approach to inverse-design photonics based on desired performance, with fabrication constraints and structure robustness incorporated in design process. Our approach performs physics guided search through the full parameter space until the optimal solution is reached. Resulting device designs are non-intuitive, but are fabricable using standard techniques, resistant to temperature variations of hundreds of degrees, typical fabrication errors, and they outperform state of the art counterparts by many orders of magnitide in footprint, efficiency and stability. This is completely different from conventional approach to design photonics, which is almost always performed by brute-force or intuition-guided tuning of a few parameters of known structures, until satisfactory performance is achieved, and which almost always leads to sub-optimal designs.

Apart from integrated photonics, our approach is also applicable to any other optical and quantum optical devices and systems.

Biography

 **Jelena Vuckovic** (PhD Caltech 2002) has been a faculty member at Stanford since 2003, where she is currently a Professor of Electrical Engineering and by courtesy of Applied Physics, and leads the Nanoscale and Quantum Photonics Lab. She has received numerous awards, including the Humboldt Prize, the Hans Fischer Senior Fellowship (from the Institute for Advanced Studies at the Technical University in Munich), the Presidential Early Career Award for Scientists and Engineers (PECASE), DARPA and ONR Young Faculty Awards. Vuckovic is a Fellow of the American Physical Society (APS) and of the Optical Society of America (OSA).