

## High-Performance Simulations for Silicon Photonics using VSim

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**Abstract** – We present several cases of simulating very large devices, including an Array Waveguide Grating and Echelle Grating, with calculation of figures of merit, such as S parameters, from postprocessing. These simulations are carried out using massive parallelism, which enables accurate simulations with 10's of billions of cells. Second-order accurate solvers have been developed, for both the time domain and for mode solvers; convergence results will be presented. This ability to carry out such large-scale simulations allows one to elucidate wave-optics effects in these devices. These simulations use the Tech-X simulation tool VSim, which was developed for massively parallel simulations, efficiently utilizes thousands of cores. With the front end, VSimComposer, one import GDS, STEP and STL files, and one can visualize the geometries and meshing, thereby allowing one to catch setup errors before launching the simulation. The resulting data files are too large to load on a workstation, and so VSimComposer uses client-serve visualization to permit visualization of these large datasets.

**Bio** – John R. Cary is a founder of Tech-X Corporation and a professor of Physics in University of Colorado in Boulder. He is the architect of VSim and leads the development of this code. His latest efforts are directed towards increasing performance of VSim on modern platforms including GPU implementation. He served as a Chair of the Division of Plasma Physics of the American Physical Society in 2018-2019. John is a Fellow of American Physical Society; Senior Member, IEEE; a winner of the NPSS Charles K. Birdsall Award for Contributions to Computational Nuclear and Plasma Sciences (2016) and the John Dawson Prize for Numerical Simulation of Plasmas - Lifetime (2015).