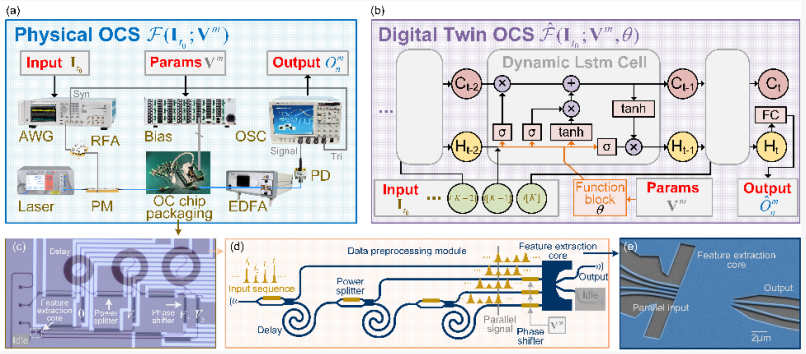
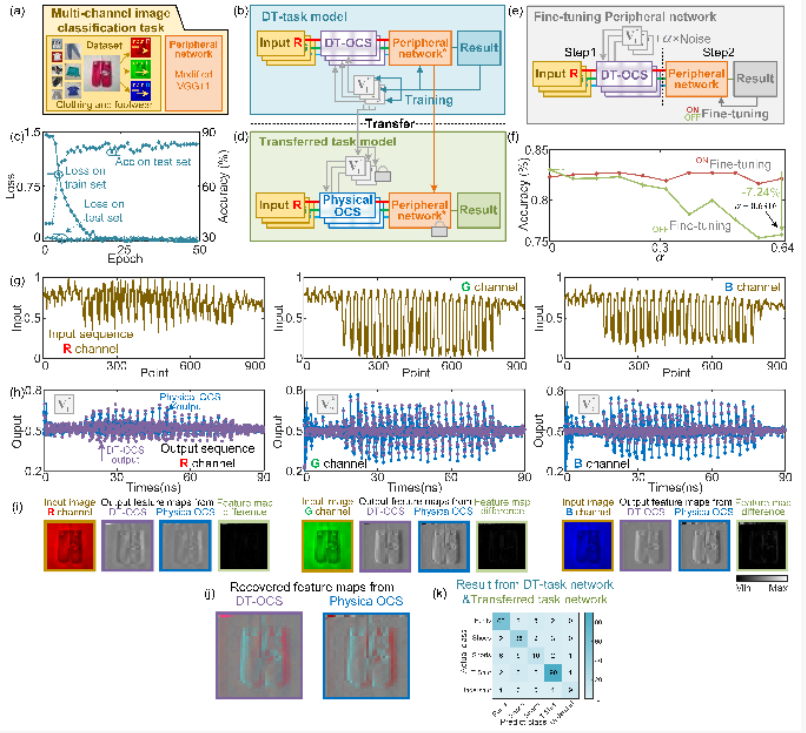
Digital Twin Platform Opens New Path to Faster, Hardware-Free Optical Computing Development

SHANNON, CLARE, IRELAND, September 7, 2026 /EINPresswire.com/ -- A new digital twin optical computing system could dramatically simplify the development of high-speed optical computing applications by allowing developers to train and optimize tasks without continuous access to physical optical hardware.



Physical Optical Computing System and Its Digital Twin

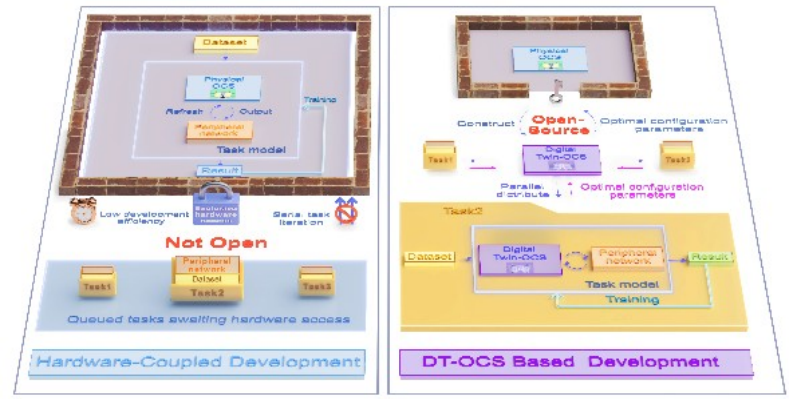
The new Digital Twin Optical Computing System (DT-OCS) creates a software-based counterpart of a specific physical optical computing system, reproducing its end-to-end computational behavior across different operating configurations. The approach addresses a major obstacle facing optical computing: many existing development workflows depend on repeated access to physical devices for configuration, optimization and testing, making development difficult to scale or conduct in parallel.



The digital twin system supports offline training and final deployment for the Fashion-MNIST classification task.

Developed by a team from Tsinghua University and the National University of Defense Technology, DT-OCS was implemented as a callable software module and demonstrated using a 10 GHz silicon-based integrated optical computing system. Once tasks have been optimized using the digital twin, the resulting

configuration parameters can be transferred directly to the physical system without additional hardware-based retraining or post-deployment fine-tuning.



Application Framework of the Digital Twin Optical Computing System

The platform demonstrated its capabilities across several applications. In handwritten digit recognition, the digital-twin task model achieved 98.09% classification accuracy, while the transferred physical model reached 98.11%. For a more complex color clothing and footwear classification task, both digital and transferred models achieved 83.07% accuracy, demonstrating consistent performance after transferring the optimized parameters to physical hardware.

DT-OCS also demonstrated major potential for accelerating optimization. In a gold trading strategy application used to test temporal decision-making, training that previously required approximately 1.74 days with the physical optical system was completed using DT-OCS in just 10.7 minutes, less than 0.4% of the original training time.

Because DT-OCS exists as a reproducible software model, multiple instances can operate simultaneously, enabling parallel task development without competing for access to the same physical optical hardware. This could make advanced optical computing platforms more accessible while supporting faster experimentation, reproducible benchmarking and development across multiple applications and users.

The open-source DT-OCS framework also provides a foundation for developing increasingly complex hybrid optoelectronic computing systems, potentially helping transform optical processors from specialized hardware platforms into more flexible and widely accessible software-enabled computing resources.

Keywords: digital twin system, high-speed optical computing, transfer training method
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ISSN: 2096-4579
CN: 51-1781/TN
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Sun R, Li YM, Fu TZ et al. Digital twin optical computing system. Opto-Electron Adv 9, 250254 (2026). DOI: 10.29026/oea.2026.250254

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