Hi all,

Here is what's been going on in medical physics and related areas the last 24 hours. Here's what you folks might find interesting today:

TOP PICKS

Novel Architectures and Objectives for Imaging / Imaging Physics and Reconstruction UMPIRE-Net: Unrolled Magnitude-Phase Regularization Network for Accelerated MRI This paper introduces UMPIRE-Net, a physics-driven deep learning method that tackles accelerated MRI with partial Fourier imaging by decoupling magnitude and phase regularization. Most existing unrolled networks implicitly couple these components in a single complex-valued representation, which can be suboptimal when phase recovery is critical. UMPIRE-Net introduces separate learned regularizers for magnitude and phase, paired with a novel data-fidelity formulation that enforces measurement consistency. By explicitly modeling these components, the method reduces reliance on externally estimated phase information and yields sharper images with fewer artifacts compared to conventional complex-valued baselines. This is a solid conceptual step forward for forward-model-aware architectures in MRI reconstruction.

Radiotherapy and Hadron Therapy Focal-point scanning for dose delivery and optimization with focused laser-accelerated very-high-energy electron beams This work presents Focal-Point Scanning (FPS), a dose delivery and optimization method for laser wakefield accelerator-driven very-high-energy electron (VHEE) beams. The method uses a two-dipole focusing system to distribute focal points throughout the planning target volume while dynamically selecting incidence sectors to avoid nearby organs at risk. In benchmarks, FPS significantly reduced mean doses to critical structures compared to parallel VHEE and intensity-modulated x-ray plans, approaching the performance of proton pencil-beam scanning. The robustness of this planning strategy across various energy spreads and spectra is particularly relevant for the future of compact, high-gradient radiotherapy systems.

Uncertainty Quantification and Likelihood-Free Inference TRIAGE: Risk-Controlled Pseudo-Label Admission for Annotation-Efficient Semi-Supervised Retinal OCT Classification TRIAGE brings conformal prediction into the semi-supervised learning pipeline for retinal OCT classification. The framework uses a patient-level conformal risk controller with an asymmetric cost matrix to manage the admission of pseudo-labels, directly addressing the clinical danger of under-grading diseases. By integrating this with a hierarchical classifier and a context-aware Transformer teacher, the system maintains high accuracy even with a tiny fraction of labeled data. This work is a great example of using calibrated, risk-aware uncertainty quantification to safely leverage unlabeled medical data, moving beyond naive confidence-thresholding.

Imaging Physics and Reconstruction / Transferable Methods from Adjacent Fields Multiphase-Diff: Diffusion-Based Generative Modeling for High-Contrast Multiphase Physical Systems with Sharp Interfaces This paper tackles the difficult problem of applying physics-constrained diffusion models to high-contrast, sharp-interface multiphase fields. The authors identify key failure modes in standard approaches, such as singular gradient terms at coefficient jumps and the erasure of low-magnitude phases by the diffusion noise floor. To solve this, they introduce a conservative flux residual to avoid differentiating discontinuous coefficients, an analytic bijective representation to guarantee coefficient positivity, and a Jacobi-preconditioned likelihood for balanced supervision. While demonstrated on physical systems, the rigorous treatment of interface physics and extreme contrast in generative models offers highly transferable insights for medical image synthesis and reconstruction.

Back tomorrow with more!

P.S. In the most recent submission window: physics.med-ph: 6 papers cs.CV: 86 papers