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

IMAGING PHYSICS AND RECONSTRUCTION

Bi-PT: Bidirectional Cross-Attention Point Transformers for Four-Chamber Heart Reconstruction from Sparse Cardiac MRI Data

This one stands out because it is not just another segmentation or reconstruction benchmark paper; it tackles *shape reconstruction from sparse clinical CMR* with a fairly explicit geometric formulation. The key idea is to use bidirectional cross-attention between an atlas and the sparse point cloud extracted from routine long-axis and short-axis MRI, then drive atlas deformation with a Neural ODE parameterized as a per-point affine transform plus translation. What makes it especially relevant is the claim of a *locally affine diffeomorphic deformation*, which is much closer to the kind of geometry-aware modeling that tends to transfer well to registration and anatomical reconstruction problems. I also like that they inject semantic labels directly into the Chamfer-style correspondence objective, rather than treating correspondence and anatomy as separate problems. If the method is as stable as advertised, it could be a useful template for sparse-view anatomical modeling where clinical acquisition protocols are fundamentally limited. This feels aligned with interests in **novel architectures for imaging** and geometry-aware medical image analysis.

Cardiac MRI Through-Plane Super-Resolution Guided by Reference and Memory

This paper is relevant because it goes after a very practical MRI limitation, namely anisotropic cardiac acquisitions, but does so with a more structured design than a plain SR network. Their STRMSR framework uses *subject-specific high-resolution reference views* plus a memory bank of intermediate SR outputs, with coarse-to-fine contextual matching to handle misalignment between target and reference images. The dynamic patch-wise feature aggregation is the most interesting part to me, since it tries to decide locally when transferred information is trustworthy rather than fusing everything uniformly. The memory mechanism for slice-to-slice consistency is also a sensible addition for 3D cardiac volumes, where through-plane hallucinations can otherwise become inconsistent across neighboring slices. This is still an application paper, but it has enough architectural structure to be worth a look if you care about clinically realistic reconstruction and super-resolution. I would file it under **imaging physics and reconstruction**, with moderate translational value.

NOVEL ARCHITECTURES AND OBJECTIVES FOR IMAGING

Widest-Path Reachability Fields for Connectivity-Preserving Slender Structure Segmentation

This is probably the most methodologically distinctive paper in the list. The authors identify a concrete optimization failure mode, *topological gradient starvation*, where standard overlap losses underweight the sparse bottleneck pixels that actually determine connectivity, and they respond with a differentiable max-min reachability objective. The proposed WPRF loss is appealing because it avoids the usual topology-aware machinery like post hoc skeletonization or homology computation, and instead directly routes gradients through connectivity bottlenecks using dynamic programming on a graph. That makes it much more interesting than a routine "topology-aware loss" paper, especially if you care about segmentation objectives that encode structural constraints rather than just pixel overlap. Although the examples include retinal vessels and oral microvessels rather than CT/MRI reconstruction, the core idea looks transferable to

vessel, airway, catheter, and other thin-structure problems in medical imaging. For your interests, this is a strong **novel objective for imaging** paper with good cross-domain portability.

Heterogeneity-Adaptive Diffusion Schrodinger Bridge for PET-Guided Whole-Body MRI Translation

Among the generative papers, this is the one I would prioritize because it is not just "diffusion for image translation" in a generic sense. They formulate PET-to-MRI translation as a *Schrodinger bridge stochastic transport problem*, then explicitly adapt the bridge dynamics using region context embeddings and PET-derived lesion guidance. The dual-stage guidance is the notable contribution: PET modulates the forward diffusion noise spatially, and PET features are also used during the reverse process to selectively amplify lesion-relevant structures. That is a more physics- and task-aware use of multimodal guidance than standard conditioning, especially for whole-body imaging where anatomical heterogeneity is a real failure mode. If the bridge formulation is implemented well, it could be relevant to broader work on multimodal reconstruction, synthesis, and uncertainty-aware generative modeling in medical imaging. This fits best under **imaging physics and reconstruction**, with some spillover into probabilistic modeling.

Other notable mentions

TRACE-Seg3D: Counterfactual Context Auditing For Robust 3D Glioma Segmentation Under Institutional Shift is worth a skim for its *counterfactual auditing* angle. It is less about a new segmentation architecture and more about reliability assessment under domain shift, but the idea of varying imaging context while preserving lesion evidence is a useful framing for robustness evaluation.

Compass: Prostate Cancer Detection Needs Multi-View Context looks clinically thoughtful, especially because it mirrors how experts read micro-ultrasound studies as videos rather than isolated frames. The novelty is more workflow-aware than foundational, so I would treat it as translational rather than method-defining.

I would *deprioritize* **From Data Completeness to Data Sufficiency: A Task-Driven Imaging Framework for Intraoperative CBCT under Quality-Time-Dose Trade-offs** for this digest because the abstract explicitly describes it as a *review*. The framing is actually quite relevant to intraoperative CBCT and quality-time-dose trade-offs, but it does not meet the novelty bar for top picks.

Back tomorrow with more!

P.S. In the most recent submission window: physics.med-ph: 2 papers cs.CV: 85 papers