Stable Long-Horizon Prediction of Parametric PDE Solution with Latent-Tensor Vision Transformers

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Abstract

This is a joint work with Iva Mikuš and Boris Muha (University of Zagreb). We study deep-learning surrogates for time-dependent parametric PDEs in an autoregressive rollout setting, where long-horizon accuracy is limited by error accumulation. We propose a parameter-aware encoder–transformer–decoder architecture: a fully convolutional encoder compresses each snapshot to a latent tensor, a vision transformer advances it in time, and a decoder reconstructs the fields. PDE parameters are injected at multiple stages (via FiLM-type modulations and a parameter token), and spatial information is provided through coordinate channels. Training uses short-window scheduled sampling to mitigate exposure bias. On a parametric advection–diffusion–reaction benchmark and on 2D Navier–Stokes flow past a cylinder (joint velocity–pressure prediction), we obtain improved rollout accuracy over latent-vector ROM baselines and plain full-field transformer models, with fewer trainable parameters.

References

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