Contribution ID: **930** Type: **Poster Presentation**

Reshaping the Imaging Landscape: AI-Supercharged Swin Transformer for Unprecedented Detail

Tuesday, 14 May 2024 09:25 (1h 30m)

Super-resolution imaging, a transformative technique spanning various scientific disciplines, holds the potential to revolutionize our understanding of complex porous structures within the realm of porous media and modeling. Traditional imaging approaches often struggle to capture the intricate details of porous media's intricate structures. To overcome this limitation, our research employs advanced AI-driven super-resolution methods, aiming to transcend inherent resolution constraints. Our goal is to bridge the gap between large-scale imaging methods, which excel at capturing macroscopic features, and small-scale techniques known for their detailed focus. By developing techniques to reconstruct high-resolution representations from lower-resolution inputs, our study promises a profound characterization of porous media's internal architecture, critical for applications such as filtration, oil recovery, and groundwater flow.

Our research journey embarked with a meticulous exploration of AI-based super-resolution techniques. Initially, we employed the ESRGAN model with the rrdb net as the generator. While it exhibited commendable performance, the model's large size posed practical challenges. Subsequently, we transitioned to the SwinIR model, which delivered results characterized by their remarkable smoothness and sharpness. Building on this progress, we leveraged GAN-assisted Swin transformers, an approach that not only yielded exceptional outcomes but also presented a significantly reduced model size. This transition not only streamlined GPU memory usage during training but also accelerated the training process.

Our methodology included in-depth examinations of various loss functions, highlighting the significance of a hybrid approach that combines GAN loss and pixel loss. This novel approach proved instrumental in effectively training the model and enhancing the quality of super-resolution results. Throughout our research, we meticulously studied the individual impact of each loss function and established relevant metrics, providing a robust foundation for our study's methodology.

Beyond the advancements in super-resolution techniques, our research culminated in the development of a model capable of achieving super-resolution beyond current technological limitations. This breakthrough allowed us to push the boundaries of resolution in porous media imaging, and we validated our findings on new datasets with resolutions of 1µm, 4µm, and 16µm.

The results were nothing short of groundbreaking. We observed that our AI-driven super-resolution approach consistently outperformed conventional methods, producing images with unprecedented clarity and detail. Notably, our model achieved remarkable results even at resolutions previously considered unattainable. This newfound capability opens doors to a wealth of possibilities in the fields of porous media analysis, offering insights that were once hidden from view.

In conclusion, our research demonstrates the immense potential of AI-driven super-resolution in revolutionizing porous media imaging. By unveiling hidden details and pushing the boundaries of resolution, our findings hold promise for a wide range of applications, from enhancing filtration processes to optimizing oil recovery and improving our understanding of groundwater flow dynamics.

Acceptance of the Terms & Conditions

Click here to agree

Student Awards

I would like to submit this presentation into both awards

Country

China

Porous Media & Biology Focused Abstracts

References

Conference Proceedings

I am interested in having my paper published in the proceedings.

Primary author: Mr MENG, Yang

Co-authors: Dr TANG, Kunning; Prof. AN, Senyou; Prof. CHEN, Zhangxing

Presenter: Mr MENG, Yang

Session Classification: Poster

Track Classification: (MS22) Manufactured Porous Materials for Industrial Applications