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Characterization and Reconstruction of 3D Stochastic Microstructures Via Supervised Learning

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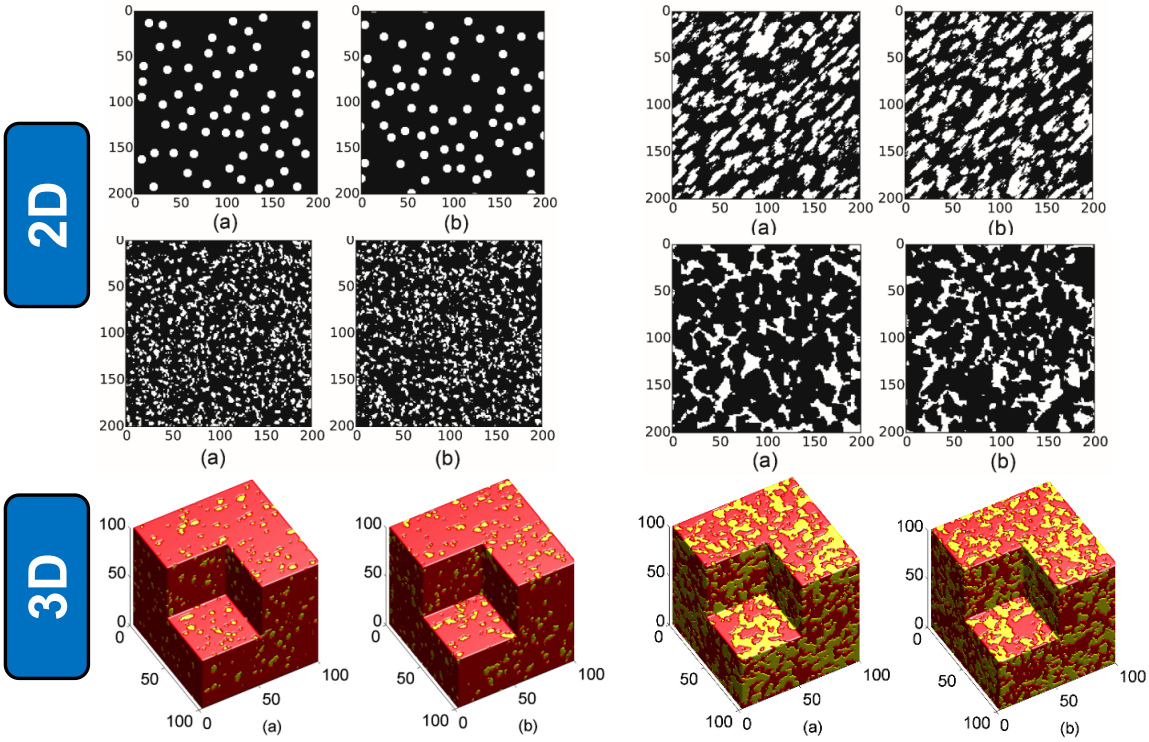

Caption: *Reconstruction through Supervised Learning: Reconstructed images in (b) are statistically equivalent to the original images in (a). The method is shown to be effective for a broad range of microstructures.*

Scientific Achievement

In this work, we extended our supervised learning based microstructure characterization and reconstruction approach from 2D to 3D. With this approach, we can quantify the statistical information of 3D microstructure with a classification tree based model, and the reconstructed 3D structure can be incorporated into 3D Finite Element simulations. Since supervised learning is a model based approach, the reconstruction speed is extremely fast and the computational cost is negligible compared to other optimization based approach.

Significance

A lot of 3D Finite Element analysis takes 3D microstructures as its inputs. With the supervised learning approach we developed, we can easily characterize the statistical information within a given 3D microstructure and generate multiple realizations of the statistically equivalent microstructures. This model-based characterization and reconstruction approach is superior in its computational efficiency of microstructure reconstruction, compared to existing methods. This method can be applied to a broad range of microstructures clustered, porous, and anisotropic.

Citation

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