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ESTIMATING RADIATIVE PROPERTIES IN ARBITRARY POROUS MEDIA USING CASE-SPECIFIC DATA – DRIVEN MACHINE LEARNING FRAMEWORKS

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ABSTRACT. Monte Carlo ray tracing (MCRT) has been a widely implemented and reliable computational method to calculate light-matter interactions in porous media. However, the computational modeling of porous media and performing MCRT becomes significantly costly while dealing with an intricate porous structure and numerous dependent variables. Hence, supervised machine learning (ML) models have been used to estimate the radiative properties. While high estimation accuracy is important, it is also crucial choosing the optimal Machine Learning framework based on the hierarchy of datasets, and the methodology used to pack the particles in a packed bed. The first model is a *Gaussian Process (GP)* model for a pack-free MCRT method, where a monodispersed spherical packed bed is studied, and it addresses the geometric complexity with the corresponding value of the penetration length probability distribution. The second model is a low-cost, physical, and geometrical-feature-based *Artificial Neural Network (ANN)* appropriate for pack-based MCRT method, used to study an overlapping circle-packed bed with lower porosity. This study reveals that these case-specific data-driven machine-learning frameworks are highly effective in predicting radiative properties in porous media, providing a promising tool for further research in this field.

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