

Super-Resolution Simulation for Real-Time Prediction of Urban Micrometeorology

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We propose a super-resolution (SR) simulation system that consists of a physics-based meteorological simulation and an SR method based on a deep convolutional neural network (CNN). The CNN is trained using pairs of high-resolution (HR) and low-resolution (LR) images created from meteorological simulation results for different resolutions so that it can map LR simulation images to HR ones. The proposed SR simulation system, which performs LR simulations, can provide HR prediction results in much shorter operating cycles than those required for corresponding HR simulation prediction system. We apply the SR simulation system to urban micrometeorology, which is strongly affected by buildings and human activity. Urban micrometeorology simulations that need to resolve urban buildings are computationally costly and thus cannot be used for operational real-time predictions even when run on supercomputers. We performed HR micrometeorology simulations on a supercomputer to obtain datasets for training the CNN in the SR method. It is shown that the proposed SR method can be used with a spatial scaling factor of 4 and that it outperforms conventional interpolation methods by a large margin. It is also shown that the proposed SR simulation system has the potential to be used for operational urban micrometeorology predictions.

Keywords: super-resolution, deep learning, building-resolving urban micrometeorology, multi-scale data assimilation, IoT

