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High PM concentration measurement with deep-learning based holographic speckle patterns. JIHWAN KIM, TAESIK GO, SANG JOON LEE[1], Pohang University of Science and Technology — A novel measurement technique of high particulate matter (PM) concentration was developed by adopting holographic speckle pattern analysis with deep learning. Conventional air-quality monitoring methods are usually cumbersome to handle and require expensive equipment for precise measurement and high throughput. The proposed technique, called Holo-SpeckleNet, can predict high PM concentration from holographic speckle patterns of PM particles. The speckle patterns of PMs were acquired for a wide range of PM concentrations, using a digital holographic microscopy (DHM) setup. Deep autoencoder (DAE) and regression algorithms were used to train the captured speckle patterns, and their concentrations were measured with a particle counter. Hyperparameter optimization and comparison with a typical convolutional neural network (CNN) algorithm were conducted to enhance measurement accuracy. The proposed measurement technique was found to exhibit high accuracy and speedy measurement under highly concentrated PM conditions unhealthy for human exposure. It would be applied to the design of a rapid, reliable, and accurate air-quality monitoring device. This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIP) (No. 2017R1A2B3005415).

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