Real-time inversion of drone electromagnetic data using deep learning methods

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Solving geophysical electromagnetic (EM) inverse problems is crucial for accurately estimating the depth and detailing the variations in electrical conductivity of subsurface structures. Traditional approaches, such as nonlinear conjugate gradient and Gauss-Newton methods, often fall short due to their tendency to get trapped in local minima and their intensive computational demands, especially in complex 3D environments or when handling uncertainties. In contrast, deep learning (DL) methods offer a novel and efficient pathway by learning to generalize the inversion process for geophysical problems. This presentation will explore various DL models that have been trained to invert frequency-domain drone EM data into subsurface resistivity profiles in real time. The developed DL models have demonstrated their capacity to accurately learn and invert parts of the 1D resistivity profiles. Specifically, in 30-layer resistivity models, our DL architectures accurately predict the resistivity of the upper 15 to 20 layers, while the resolution for deeper layers declines due to inherent limitations of the EM methods at deeper depths. Remarkably, our DL models can deliver inversion results within seconds, showcasing their potential for real-time application in geophysical studies. This rapid inversion capability marks a significant advancement over traditional methods, promising more efficient and accurate geophysical explorations in the future.