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Partial differential equations approaches to optimization and regularization of Deep Neural Networks

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Deep Neural Networks perform much better than traditional Machine Learning methods in a number of tasks. However, they lack performance guarantees, which limits the use of the technology in real world and real time applications where errors can be costly.

We will discuss recent work which applied numerical analysis and PDE approaches to (i) optimization of DNNs by stochastic gradient descent and (ii) regularization of DNNs.

We will prove that Lipschitz regularized DNNs converge, (with a rate of convergence), which implies generalization. We use at theory which is based on variational methods for inverse problems. The regularization leads to robust networks which are more resistant to adversarial examples.

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