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Some elliptic second order problems and neural network solutions: existence and error estimates. (English) [Zbl 07738648]


Summary: Recently some neural networks have been proposed for computing approximate solutions to partial differential equations. For some second order elliptic or parabolic PDEs, error estimates are proved between the solution and the computed one with neural networks, assuming this one minimizes a $L^p$ norm or a dual norm of the residual, or an abstract loss function. In this article, for some second order elliptic PDEs, thanks to a gradient flow strategy, we prove the existence of a neural network solution minimizing the loss function with respect to the neural network parameters and we give an error estimate between the solution and the computed one with neural networks. For some nonsymmetric elliptic PDEs, the problem is expressed in form of a MinMax problem which is approximating with a double NN. Thanks to a diagonal extraction process a result of convergence is established with respect to the parameters of NNs and errors estimates are also given.

MSC:
65L09 Numerical solution of inverse problems involving ordinary differential equations
65D05 Numerical interpolation
65G99 Error analysis and interval analysis
35-XX Partial differential equations
65-XX Numerical analysis

Keywords:
learning neural network; elliptic PDE; gradient flow strategy; error estimates

Full Text: DOI

References:


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