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**Parametric deep energy approach for elasticity accounting
strain gradient effects (Paper review)**

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In this work, we present a Parametric Deep Energy Method (P-DEM) for elasticity problems accounting for strain gradient effects. The approach is based on a pure deep neural network (DNN) solution of the underlying potential energy. Therefore, a cost function related to the potential energy is subsequently minimized. P-DEM does not require any classical discretization and requires only the definition of the potential energy, which simplifies the implementation. Instead of training the model in the physical space, we define a parametric/reference space similar to isoparametric finite elements, which is in our example a unit square. The inputs are naturally normalized preventing gradient vanishing leading to much faster converges compared to the original DEM. Forward and backward mapping are established by means of NURBS basis functions. Another advantage of this approach is that Gauss quadrature can be employed to approximate the total potential energy that is the loss function calculated in the parametric domain. Backpropagation available in PyTorch with automatic differentiation is performed to calculate the gradients of the loss function with respect to the weights and biases. Once the network is trained, a numerical solution can be obtained in the reference domain and then is mapped back to the physical domain. The performance of the method is demonstrated through various numerical benchmark problems in elasticity and compared to analytical solutions. We also consider strain gradient elasticity, which poses challenges to conventional finite elements due to the requirement for C1 continuity.