Methamodel for the hydraulic fracturing

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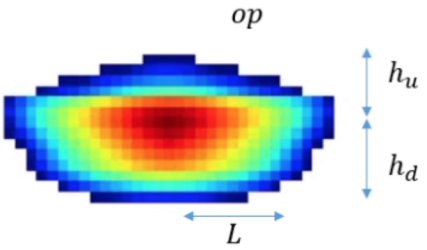
While performing a preliminary design of hydraulic fracturing, it is convenient to use approaches that will help you quickly to carry out multivariate calculations with high accuracy. One of such approaches is surrogate modeling. The key idea is in carrying out preliminary calculations, then performing a multidimensional interpolation with the involvement of machine learning methods.

For building the model, computations was performed on the Planar 3D model. The calculation of stresses was carried out by the boundary element method, the flow of hydraulic fracturing with proppant was calculated in the approximation of the lubricating layer. The system of equations was solved by means of the implicit scheme and, after discretization, was split into geomechanical and hydrodynamic parts, each of which was calculated independently within one time step. The system of hydrodynamic equations was solved by BiCGStab with preconditioning.

In the task of generating input data, the flow of three power law hydraulic fracturing fluids, a power curve of the proppant concentration was set and 3 injection stages was considered. The environment in which the hydraulic fracturing was carried out had five layers. Thus, a 25 dimensional parameter space was obtained. The output parameters of the problem were considered the length of the fracture, the height up and down from the injection point and the aperture in the center of the fracture. A total of 25 thousand calculations were performed.



Various machine learning methods were tried, but Ridge linear regression with a core and a neural network such as an encoder with separate processing of geomechanical and hydrodynamic input data showed the best results. For the latter case, the error in determining the output parameters was about 10%.

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