Scaling of the Planar3D model into the multilayered media for practical applications

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At the current moment, the Planar3D model of hydraulic fracturing are usually considered as the most accurate and efficient model for all types of planar fractures, including the fractures into the highly heterogenic reservoirs. Furthermore, for many practical applications the Planar3D model has comparatively low evaluation speed. For example, in problems of economical optimization, development of the fracture design concept and the problem of the pump test interpretations, a big number of fracture geometry valuations are needed.

Thus, some proxy- or metamodels on the basis of the Planar3D model are required. On the one hand such models may have a greater evaluation speed. On the other hand they will be in good agreement with the Planar3D model. Although some sort of metamodel on the basis of the Planar3D model will be the solution of the problem, it has their own disadvantages. These kinds of models can be efficient only while they use a minimum amount of initial parameters. In other cases, when the dimension of the parametric space of the problem is high, the accuracy of the proxy or metamodeling will be pure.

Most of the real hydrofracturing jobs are conducted into the multilayered media, and thus, the dimension of the problem is proportional to the number of the layers into the geomechanical model. In many cases, geomechanical model may have 100-200 different layers. Nevertheless, it is obvious that in many cases geomechanical model can be simplified “manually” without losses in the accuracy of the hydrofracturing models. In general cases, however, the way to automatically simplify an arbitrary 1D-geomechanical model is unclear.

To solve this problem, the 1d-geomechanical model was described as the Fourier series. In the proposed work the dimensionless formulation of the Planar3D into multilayered model was obtained, and the full set of the dimensionless parameters of the equation was derived. Using the set of small dimensionless parameters into the equations of the Planar3D model into multilayered media, the high frequencies of the Fourier series were neglected, and thus, the dimension of the problem rapidly reduced. Fracture geometry on the reduced geomechanical model in good agreement with the original one.