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# On fracture mechanics analysis using B-spline wavelet finite element method

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## Summary

In this study, fracture mechanics analysis using B-spline wavelet Galerkin method is carried out. B-spline scaling function and wavelets are used as the basis functions in the Galerkin formulation. It is very easy to integrate and differentiate compared with other kind of wavelet basis functions, such as Daubechies wavelet basis function. Furthermore, they have the so called multiresolution properties. The spatial resolution of the basis functions can be enhanced in the regions of high stress and strain gradients by superposing finer wavelet basis functions. The B-spline wavelet Galerkin method can be considered as a kind of fixed grid approach. A solid or structure is descretized equally spaced structured cell. Numerical integration are conducted based on them. The outer boundaries are represented by performing or not performing the integration. To accurately represent the boundary, a sub-cell approach is applied. Then, it is simple to generate an analysis model for a complex shaped structure. There are no finite element mesh in classical sense. Then, it can be classified to be a kind of meshfree method.

In this methodology, there are some difficulties in dealing with external boundaries. They are due to the loss of linear independence of the basis functions. To circumvent these problems, we introduce the modified scaling function/wavelets or eliminate particular basis functions that can be expressed by the linear superposition of the other basis functions. Furthermore, to carry out the analyses efficiently, an adaptive strategy based on the posteriori error estimation is developed. The error estimation are carried out in each integration cells and the different wavelets of finer length scales are added where numerical error is large.

Fracture mechanics analyses using B-spline wavelet Galerkin method are able to add enrichment functions to the original wavelet basis functions which contain a discontinuous displacement field. The stress concentration region around the crack tip can represent by superposing diffelent length scale wavelets. Equivalent domain integral method are adopted to calclate energy release rate. In this presentation, mathematical formulation and numerical examples for the two dimensional elastic crack problems are adopted.