The 2019 World Congress on
Advances in Structural Engineering and Mechanics (ASEM19)
Jeju Island, Korea, September 17 - 21, 2019

Keynote Paper

Introduction to the strain-smoothed element method for analysis of solid and shell problems

Chaemin Lee[1)], Cheolgyu Hyun[2)], *Phill-Seung Lee[3)]

[1),2),3)] *Department of Mechanical Engineering, KAIST, Daejeon 34141, Korea*
[3)] phillseung@kaist.edu

ABSTRACT

We introduce the strain-smoothed element (SSE) method recently developed for analysis of solid and shell problems. The strain-smoothed 3-node triangular and 4-node tetrahedral solid elements and 3-node triangular shell element were developed. Unlike smoothed finite element methods (S-FEMs), the SSE method requires no special smoothing domain and linear strain fields are formed within elements. The strain-smoothed elements pass the basic tests (isotropy, patch and zero energy mode tests) and show significantly improved convergence behavior in various numerical examples. The method could be easily extended for solving non-linear problems.

REFERENCES

Liu, G.R., Nguyen-Thoi, T., Lam, K.Y. (2009), “An edge-based smoothed finite element method (ES-FEM) for static, free and forced vibration analyses of solids,” *J. Sound* Vib., **320**, 1100-30.

Lee, C., Lee, P.S. (2018), “A new strain smoothing method for triangular and tetrahedral finite elements,” *Comput. Methods Appl. Mech. Eng.*, **341**, 939-955.

Lee, C., Lee, P.S. (2019), “The strain-smoothed MITC3+ shell finite element,” *Comput. Struct.*, **223**.

Jun, H., Yoon, K., Lee, P.S., Bathe, K.J. (2018), “The MITC3+ shell element enriched in membrane displacements by interpolation covers,” *Comput. Methods Appl. Mech. Eng.*, **337**, 458-80.

Kim, S., Lee, P.S. (2018), “A new enriched 4-node 2D solid finite element free from the linear dependence problem,” *Comput. Struct.*, **202**, 25-43.

Kim, S., Lee, P.S. (2019), “New enriched 3D solid finite elements: 8-node hexahedral, 6-node prismatic, and 5-node pyramidal elements,” *Comput. Struct.*, **216**, 40-63.

Lee, Y., Lee, P.S., Bathe, K.J. (2014), “The MITC3+ shell element and its performance,” Comput. Struct., **138**, 12-23.

Ko, Y., Lee, P.S., Bathe, K.J. (2017), “A new 4-node MITC element for analysis of two-dimensional solids and its formulation in a shell element,” *Comput. Struct.*, **192**, 34-49.