The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

Abstract stability result for perturbed saddle-point problems: Construction and analysis of iterative splitting schemes and preconditioners in poromechanics

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Keywords: *poromechanics, perturbed saddle-point problems, well-posedness, small inf-sup condition, parameter-robust splitting schemes, uniform preconditioners*

In this talk we discuss a new abstract framework for the well-posedness analysis of saddle-point problems which allows to derive the stability condition according to Babuška's theory also in presence of arbitrary (symmetric negative semidefinite) perturbations from a small inf-sup condition, similar to the famous Ladyzhenskaya-Babuška-Brezzi (LBB) condition, and the other standard assumptions in Brezzi's theory [1].

This abstract result generalizes Brezzi's splitting theorem and not only allows for a simple analysis of perturbed saddle-point problems but also guides the design of uniformly convergent iterative splitting schemes and parameter-robust preconditioners for this class of problems. These benefits are demonstrated with several examples of poromechanics models and their discretizations.

REFERENCES

[1] Q. Hong, J. Kraus, M. Lymbery, and F. Philo, A new framework for the stability analysis of perturbed saddle-point problems and applications. *arXiv:2103.09357 [math.NA]*, 2021.