

AN INVERSE SOURCE PROBLEM FOR FOCUSING WAVE ENERGY TO SUBTERRANEAN FORMATIONS

Pranav M. Karve¹, Chanseok Jeong² and Loukas F. Kallivokas³

¹ The University of Texas at Austin, 301 East Dean Keeton St., Stop C1747, Austin, TX 78712, USA,
pranav.karve@utexas.edu

² The Catholic University of America, 620 Michigan Avenue N.E., Washington, DC 20064, USA,
jeong@cua.edu

³ The University of Texas at Austin, 301 East Dean Keeton St., Stop C1747, Austin, TX 78712, USA,
loukas@mail.utexas.edu

Key Words: *Inverse source, energy focusing, wave propagation, EOR.*

We discuss a partial-differential-equation-constrained optimization approach for constructing optimal excitations capable of imparting a maximal mobility outcome to a target subterranean formation, by steering the focusing of the excitation energy to the formation. The motivation stems from the possibility of “shaking” sufficiently strongly (via ground, wellbore, or other sources) a target reservoir zone to increase oil mobility. However, the applications are not limited to enhanced oil recovery (EOR) purposes, but could also extend to medical applications.

The method leads formally to an inverse source problem, where the tempo-spatial characteristics of the source excitation are sought in order to maximize the kinetic energy, the acceleration field, the fluid motion, or other mobility metrics, in the targeted elastic or poroelastic formation, subject to the physics of the associated wave propagation problem. The inverse source problem is resolved on a PML-truncated finite computational domain using a hybrid method (a conventional single-field formulation for the probed domain coupled with a mixed approach for the PML) that is dealt with numerically using finite elements.

We report numerical experiments in idealized heterogeneous elastic and poroelastic formations, which show robustness of the optimization scheme. We also discuss practical strategies for optimal illumination of the targeted formations.

REFERENCES

- [1] C. Jeong, C. Huh, L.F. Kallivokas, L.W. Lake, “Optimization of sources for focusing wave energy in targeted formations,” *Journal of Geophysics and Engineering*, 7, 242-256, 2010.