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Nonlinear acoustic acceleration waves in porous media flow

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Acoustic acceleration waves are defined as jumps in the first derivatives of the velocity, pressure, or density across a propagating singular surface (i.e., wavefront). In this talk, the temporal evolution of the amplitude and the propagation speed of such waves are investigated in the context of weakly nonlinear acoustic propagation in Darcy-type porous media. It is shown that there exists a critical value, $\alpha^*(> 0)$, of the initial jump amplitude such that the acceleration wave magnitude either goes to zero as $t \to \infty$ or blows-up in finite time, depending on whether the given initial jump amplitude is less than or greater than α^*. In addition, a connection to traveling wave solutions is noted, wherein the Lambert W-function is encountered, and the linearized case is examined. Finally, the numerical solution of a (1D) nonlinear IBVP involving sinusoidal signaling in a fluid-saturated porous slab is used to illustrate the finite-time transition from acceleration to shock wave, which occurs when the initial jump amplitude is greater than α^*. [Supported by ONR/NRL funding (PE 061153N).]