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Nonlinear Poroacoustic Flow in Rigid Porous Media

An acoustic acceleration wave is defined as a propagating singular surface (i.e., wavefront) across which the first derivatives of the velocity, pressure, or density exhibit jumps. In this talk, the temporal evolution of the amplitude and speed of such waves are investigated in the context of nonlinear acoustic propagation in rigid porous media, where the fluid-solid interaction is described by Darcy's well known resistance law. It is shown that there exists a critical value, the constant α^* (>0), of the initial jump amplitude. It is then established that the acceleration wave magnitude either goes to zero, as $t \to \infty$, or blows up, in finite time, depending on whether the initial jump amplitude is less than or greater than α^*. Additionally, numerical solutions of an idealized, nonlinear initial-boundary value problem involving sinusoidal signaling in a fluid-saturated porous slab are used to illustrate the finite-time transition from acceleration to shock wave, which occurs when the initial jump amplitude is greater than α^*, and comparisons with the linearized case (i.e., the damped wave equation) are presented whenever possible. Finally, the related phenomenon of poroacoustic traveling waves, where an exact analytical solution is possible in terms of the Lambert *W*-function, is briefly considered and connections to second-sound (i.e., thermal wave) phenomena are noted. (Work supported by ONR/NRL funding).

Pedro Jordan received a PhD in Engineering and Applied Science from the University of New Orleans in August, 1999. Since then he has worked for the U. S. Naval Research Laboratory at NASA's Stennis Space Center in Mississippi. Since 1999 Dr. Jordan has, in all, published, had accepted for publication, and submitted ~ 65 articles in/to peer-reviewed publications. While he has worked mainly in continuum mechanics, both with fluids and solids, he has also published on topics from applied analysis, numerical analysis, electromagnetic theory, and mathematical biology. Dr. Jordan, who has both conducted and participated in workshops at Oxford and Durham Universities in the U.K., held the Grey College Mathematics Fellowship at Durham University in 2004 and 2007. In 2005, and again in 2006, Dr. Jordan received an Alan Berman Research Publication Award from the U.S. Naval Research Laboratory for his work in nonlinear acoustics; and in 2007, he received the Top Scientists/Engineers Award from The Dept. of the Navy, again for his work in nonlinear acoustics. And in 2008 Dr. Jordan joined the board of the journal *Mechanics Research Communications* as an Associate Editor.

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