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Integral Form Solutions of the Linearized Navier-Stokes Equations without Deviatoric Stress Tensor Term in the Forward Modeling for FWI

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Abstract : Navier-Stokes equations (NSE), which describe the dynamics of a fluid, have an important application on modeling waves used for data inversion techniques as full waveform inversion (FWI). In this work a linearized version of NSE and its variables, neglecting deviatoric terms of stress tensor, is presented. In order to get a theoretical modeling of pressure p(x,t) and wave velocity profile c(x,t), a wave equation of visco-acoustic medium (VAE) is written. A change of variables p(x,t)=q(x,t)h(ρ), is made on the equation for the VAE leading to a well known Klein-Gordon equation (KGE) describing waves propagating in variable density medium (ρ) with dispersive term α^2(x). KGE is reduced to a Poisson equation and solved by proposing a specific function for α^2(x) accounting for the energy dissipation and dispersion. Finally, an integral form solution is derived for p(x,t), c(x,t) and kinematics variables like particle velocity v(x,t), displacement u(x,t) and bulk modulus function k_b(x,t). Further, it is compared this visco-acoustic formulation with another form broadly used in the geophysics; it is argued that this formalism is more general and, given its integral form, it may offer several advantages from the modern parallel computing point of view. Applications to minimize the errors in modeling for FWI applied to oils resources in geophysics are discussed.

Keywords : Navier-Stokes equations, modeling, visco-acoustic, inversion FWI
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