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Uncertainty based pressure reconstruction from velocity measurement with generalized least squares JIACHENG ZHANG, CARLO SCALO, PAVLOS VLACHOS, Purdue University West Lafayette — A method using generalized least squares reconstruction of instantaneous pressure field from velocity measurement and velocity uncertainty is introduced and applied to both planar and volumetric flow data. Pressure gradients are computed on a staggered grid from flow acceleration. The variance-covariance matrix of the pressure gradients is evaluated from the velocity uncertainty by approximating the pressure gradient error to a linear combination of velocity errors. An overdetermined system of linear equations which relates the pressure and the computed pressure gradients is formulated and then solved using generalized least squares with the variance-covariance matrix of the pressure gradients. By comparing the reconstructed pressure field against other methods such as solving the pressure Poisson equation, the omni-directional integration, and the ordinary least squares reconstruction, generalized least squares method is found to be more robust to the noise in velocity measurement. The improvement on pressure result becomes more remarkable when the velocity measurement becomes less accurate and more heteroscedastic. The uncertainty of the reconstructed pressure field is also quantified and compared across the different methods.

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