

Symmetry-based observers for some water-tank problems: theory and application to an oceanography example.

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In this talk we consider a tank containing fluid and we want to estimate the horizontal currents when the fluid surface height is measured everywhere. The fluid motion is described by shallow water equations in two horizontal dimensions.

We propose a class of simple non-linear estimators whose structure is based on a list of formal requirements: rotation and translation invariance, robustness to noise, and local convergence of the state estimation error to zero. The resulting estimators are observers whose correction terms are based on a smoothing of the measured surface height (convolution with smooth isotropic kernels).

We prove that in numerical applications, local exponential convergence is expected. The estimator is also applied to the problem of predicting the ocean circulation. Realistic simulations illustrate the relevance of the approach compared with some standard (variational) oceanography techniques.