Time series analysis of turbulent bubbly flow

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Hot-wire anemometry is one of the standard techniques for measurements in turbulent two phase flows. The time series contains valuable information about the local properties of the fluid as well as the gaseous phase. However, the disentanglement of the fluid and gaseous part of the signal is intricate. Hitherto methods require an a priori knowledge of probability distribution of the signal or its derivatives. At low Reynolds number this distribution is bi–modal and therefore an optimal (Bayesian) classifier can be derived. At high Reynolds number turbulent flow, this assumption is in general not valid. This leads to faulty classification due to intermittency or strong velocity fluctuations. We propose a novel algorithm which reformulates the problem of local phase detection as an general pattern recognition task. The algorithm consists of an optimal signal decomposition using adaptive wavelet transform. The classification is done with neural network based trained classifier. The performance of the algorithm is validated for turbulent bubbly flow at various Reynolds numbers and void fractions. We compare methods to disentangle the bubble signal from that of the continuous phase. In particular, we discuss the evaluation of structure functions and velocity spectra, focusing on the scaling properties.