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**Ramesh Yapalparvi\*** (ramesh.yapalparvi@gmail.com), 2525 Pottsdamer St, Tallahassee, FL 32310, and **Bartosz Protas**. *Computation of Effective Free Surfaces in Two Phase Flows*. Preliminary report.

In this investigation we revisit the concept of “effective free surfaces” arising in the solution of the time-averaged fluid dynamics equations in the presence of free boundaries. This work is motivated by applications of the optimization and optimal control theory to problems involving free surfaces, where the time-dependent formulations lead to many technical difficulties which are however alleviated when steady governing equations are used instead. By introducing a number of precisely stated assumptions, we develop and validate an approach in which the interface between the different phases, understood in the time-averaged sense, is sharp. In the proposed formulation the terms representing the fluctuations of the free boundaries and of the hydrodynamic quantities appear as boundary conditions on the effective surface and require suitable closure models. As a simple model problem we consider impingement of free-falling droplets onto a fluid in a pool with a free surface, and a simple algebraic closure model is proposed for this system. The resulting averaged equations are of the free-boundary type and an efficient computational approach based on shape optimization formulation is developed for their solution. (Received August 23, 2012)