Title: Improved Stable/Smooth Multiphase Flow modeling
Principal Investigator: William Bailey, Schlumberger Doll Research
Motivation: optimization is becoming an increasingly important facet of Schlumberger's service and technical offerings. One such optimization service involves that of wellbore and surface networks flow performance optimization. This then inherently utilizes Multiphase Flow (in conduit) modeling tools. It has been shown that such models (essentially correlations) can exhibit numerical instability and non-smoothness. Such behavior is not suitable for any form of optimization – which forms an important part in Schlumberger's technology strategy in the next few years.
Objective: This project aims at providing a means for stable optimization of multiphase flow computation – using both existing correlations and new ones.
Description: A number of activities are envisaged for this work and may include some (or all) of the following:

- Sensitivity analysis on various MPF correlations, identify criteria where such instability (numerical holes) emerge. This will include examination of the latest Tulsa 2-phase mechanistic models which still experience stability and performance issues.
- Drift Flux Model: Can the parameters of a simple model such as drift-flux be tuned (with say a neural network) to emulate a mechanistic model? Several years ago Stanford tuned their drift-flux model to agree with 3-phase data collected at SCR (sponsored by Jon Holmes). Seems the same approach can be used with a broad ranging data set generated by a good mechanistic model rather than expensive experimental data.
- Cost/benefit analysis of flow modeling rigor relative to optimization outcome. This would be somewhat of an extension to the preliminary work already done at SDR. Our ultimate goal is to provide optimization solutions that capture as best as possible the underlying science of the problem. To the practitioner, this needs to be both transparent while appropriate to the situation.
- Comparative study using actual wellsite logging data (i.e. from FlowScan Imager) – rather than small-scale laboratory experiments. Schlumberger has accumulated a large amount of such data – enough to perform a meaningful validation study of the most recently developed models. This would have benefits not only on the simulation side, but also the Wireline segment which for production logging applications, incorporate multiphase flow models into tools such as PLA (via PIPESIM Openlink) and BorFlow (directly).

Desired Background: Chemical Engineering, Mathematics, Petroleum Engineering, Mechanical Engineering, Civil Engineering. Exposure to Multi-phase Flow (in conduits) would be useful. Familiarity with numerical methods code.