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Imaging techniques in Oil-Water and Air-Water Multiphase flows in Pipelines

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Ubiquitous in flowlines, multiphase flow has been onerous to operators and researchers alike. Posing several flow assurance challenges, progress in multiphase flow has eluded engineers for decades. The advent of innovative measurement techniques and improved computational capabilities harbinger augmented understanding in this field.

Multiphase research at National University of Singapore, is centered around 2 experimental facilities, one for industrial scale testing (3-Phase loop) and another for a finer laboratory scale testing (HO loop). The 3 phase loop is first of its kind in Asia Pacific, boasting testing capabilities of high flow rate, high pressure of oil, water and air, scalable to 1", 2", 4" and 6" stainless steel pipelines. The HO Loop, constructed entirely out of transparent acrylic, possess finer flow control and a myriad of instrumentation capabilities including high speed camera, laser doppler velocimeter, conductance measurement, pressure drop and quick closing valves. Image processing software developed in-house were deployed for measurements on the flow line. Advantages of this technology is inherent non-intrusiveness and applications where conductance and conductivity measurements fails due to fluid adherence.

Experiments were conducted into flow regimes where flow assurance softwares such as OLGA and PIPESIM, strain to give accurate results. High speed photography and image processing techniques facilitated flow pattern identification and characterization of transitional states. Interfacial deformations under steady and unsteady conditions of oil-water and air-water flows were captured using this tool, facilitating further quantification, which shall be presented, providing refreshing data for engineers and academicians alike.

Biography

Vivek Premanadhan is a Research Scholar at National University of Singapore. He did his B.E. (Hons) from BITS Dubai after which he pursued his M.Eng. in NUS specializing in offshore and subsea engineering. Working as a research engineering he designed and constructed the Heavy Oil Facility in NUS. In 2014, he joined as a PhD student under A/Prof. LOH Wai Lam, with prime research interest into oil-water transport in pipelines.