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Neutron Radiography Imaging of Argon Bubble Flow in Liquid Gallium in External Horizontal Magnetic Field

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This work is dedicated to neutron imaging of two-phase liquid metal systems with relevance to theoretical and applied magnetohydrodynamics, as well as computational fluid dynamics. Specifically, argon bubble flow in liquid gallium in with and without the presence of external magnetic field is studied using high frame rate neutron beam transmission signal recordings obtained at the NEUTRA beamline, SINQ, PSI.

This is motivated by the fact that, among other non-invasive measurement methods available for liquid systems, optical measurements are impossible due to metal opacity, ultrasound Doppler velocimetry and transit time technique yield no information regarding bubble shapes and are imprecise in case of oscillating bubbles, while X-ray transmission methods are limited to thin liquid metal samples, which may not be representative of systems to which the probed small scale system is later upscaled. Neutron radiography allows one to potentially sidestep these issues and perform direct observations of phase distributions within metal flow.

Detailed data from such experiments would prove very useful in understanding the physics of multiphase flows, magnetohydrodynamic of otherwise, as well as for verification of numerical models. As such, the end goal of the study, a part of which this work represents, is to produce the tools that would enable as detailed and direct comparisons as possible between experiment and simulation.

The objective of the present work is to construct a robust image processing pipeline capable of extracting as much physical information as possible out of two phase flow snapshot series. The caveat is that, due to high bubble velocities and the required large field of view, the signal-to-noise ratio within the obtained images is inherently low. As a result, generating usable results is much less trivial and requires special considerations.

The first version of the developed neutron image processing routine is shown be sufficiently robust and capable of reliable recognition of bubble shapes and free surface of metal, performing velocimetry and analyzing data. This is verified by numerical simulations that reproduced the experimental setup *in silico*, where results are in good agreement with what is seen from the experiment and is expected from theoretical considerations.

Poster back-up

Yes

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