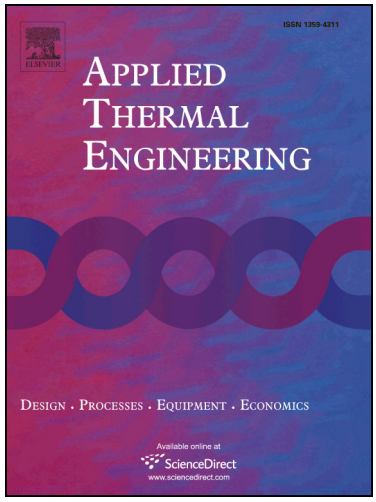

Hypothesis-testing combined with image analysis to quantify evolution of bubble swarms in a direct-contact boiling heat transfer process

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PII: S1359-4311(16)32960-X
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2016.11.004
Reference: ATE 9409

To appear in: *Applied Thermal Engineering*

Received Date: 9 June 2016
Revised Date: 15 September 2016
Accepted Date: 1 November 2016

Please cite this article as: Q-t. Xiao, J-x. Pan, J-x. Xu, H. Wang, Z-h. Lv, Hypothesis-testing combined with image analysis to quantify evolution of bubble swarms in a direct-contact boiling heat transfer process, *Applied Thermal Engineering* (2016), doi: http://dx.doi.org/10.1016/j.applthermaleng.2016.11.004

Hypothesis-testing combined with image analysis to quantify evolution of bubble swarms in a direct-contact boiling heat transfer process

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Abstract

The technology of image enhancement has been proved to be very effective and powerful in the quantification of bubbling regime, heat transfer performance and mixing efficiency in a direct contact boiling heat transfer process. In the present work, this image analysis technique was combined with some statistical hypothesis-testing tools including Kolmogorov-Smirnov test and chi-square test in order to compute the p-values for bubble images comparison. It was indicated that the employed hypothesis-testing tools are effective in testing whether the every two bubble images gray distribution have the same or close gray distribution. Specially, the different experimental cases with the same Betti numbers can be identified by using our methods. p-value represents a meaningful parameter to study the mixing transient. Testing statistics can be used to quantify evolution of bubble swarms in direct-contact boiling heat transfer process. Results obtained from the real experiment indicate that the inflection point of observed values of testing statistics is roughly equal to mixing time, which is the main merit of the employed tools.

Keywords: direct-contact heat transfer; bubble swarm patterns; image comparison; hypothesis-testing.

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