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Uncertainty and Sensitivity Analysis of Hewitt-Govan model for dryout prediction using DARIA system code

Abstract:
When it comes to the modelling of any type of the phenomena mainly the aspects of the accuracy (prediction versus measurement) are discussed and analysed in great detail. However, as measurements in the real life experiments are uncertain, the numerical prediction are burdened with uncertainties of their own kind – the numerical uncertainties, to be specific. In this work uncertainties of the predictions of the Hewitt-Govan model, which simulates the entrainment and deposition phenomena occurring in Boiling Water Reactors, are presented and discussed. Results of the Global Uncertainty Analysis are shown in terms of trends of uncertainty values with respect to the pressure, mass flux and inlet subcooling. Regions of large and small uncertainties are identified and presented in the form of a Look-Up Table.

Additionally, application of the Global Sensitivity Analysis methods allowed to quantify the sources of aforementioned uncertainties with high accuracy over large spectrum of experimental conditions. Since the computational demand for such analysis was significant DARIA system code is introduced here and validation of it's 3-field model is presented. This particular code was developed specifically to this task, with simplifications which allowed fast calculation but did not compromise the accuracy of the aforementioned models. The Look-up Table is supplemented with Sensitivity measures which indicate that the mass flux is dominant contributor to the uncertainties present in the dryout predictions in almost all considered flow conditions.

Lastly, it is shown that introduction of the Initial Entrained Fraction equal to 0.7 reduces the uncertainties by 28-35% on average depending on the considered hydraulic diameter and flow parameters. At the same time only fraction of the cases experience significant changes in the sources of said uncertainties.

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