A numerical algorithm for the solution of nonlinear equations to analyze the effect of asymmetric power distribution on the stability of boiling water reactors

S. Kumar and **G. Dutta**
Mechanical Engineering,
Indian Institute of Information Technology
Design & Manufacturing Jabalpur,
Dumna Airport Road, Mehagawan, P.O. Khamariya,
Jabalpur: 482 005, India
gd@iiitdmj.ac.in

The objective of the present paper is to develop a numerical algorithm to simulate the hydrodynamics inside the vertical channels of a boiling water reactor (BWR) core and to analyze the effect of asymmetric power distribution between the two-halves of the reactor core on its stability when the reactor is undergoing the density wave oscillations (DWOs). A set of nonlinear and hyperbolically classified partial differential equations comprising of mass, momentum and energy conservation equations along with the thermodynamic equation of state to take into account the compressibility effect of two-phase flow dynamics is discretized and solved in time domain with a characteristics based backward finite difference scheme in Eulerian frame of reference. The numerical model is then extended to analyze the parallel channel instability arising due to DWOs in the BWR core. Effect of asymmetric power distribution on two-halves of the reactor core is investigated with present model keeping the total power and mass flow rate constant in the complete reactor core. The present study is aimed to get better insight in analyzing parallel channel instability of the BWR core undergoing in-phase and out-of-phase modes of oscillations when the reactor simulations are subjected to more real-life operating conditions, i.e., the reactor simulations are to be performed taking into account the feedback of neutron dynamics on the primary circuit of thermal-hydraulics in BWR.