

Flood Risk Analysis of Cocó Urban River in Fortaleza, Brazil

Carla Freitas Andrade¹, Vanessa Ueta, Patrícia Freire Chagas, Silvia Helena Santos,
and Raimundo Souza²

Universidade Federal do Ceará, Fortaleza, Ceará, Brazil

ABSTRACT - A mathematical model based on the Saint-Venant hydrodynamic equations combined with fuzzy set theory is formulated for the flood risk analysis of Cocó urban river in Fortaleza, Ceará, Brazil, which is subjected to the propagation of a flood wave. The model is capable of evaluating the behavior of the control variables related to the flow in terms of the hydraulic and hydrological parameters of the basin. The model is also capable of evaluating the fuzzy risk for such area subjected to the flood process during intense rains. The governing partial differential equations are solved with the aid of finite differences, and for the solution of the system of nonlinear algebraic equations the iterative Newton-Raphson algorithm is employed. A computer program QUARIGUA (Risk Quantitative Analysis of Flooding in Urban Rivers) is used to perform the simulations. The computer program QUARIGUA is organized in a modular manner, with two main modules: the deterministic module, where the depth of the water in the river and the flow of the channel are calculated as discrete values; and the fuzzy module, based on the fuzzy set theory, where the depth of the water and the flow are calculated as membership functions. To evaluate the behavior of the control variables, several scenarios for the main channel as well as for the flood waves are considered and different simulations are performed. The simulations demonstrate the reliability, versatility and computational efficiency of the proposed model.

¹ Professor, Departamento de Engenharia Mecânica e de Produção, Universidade Federal do Ceará, Fortaleza, Ceará, Brazil. Email: carla@ufc.br

² Professor, Departamento de Engenharia Hidráulica e Ambiental, Universidade Federal do Ceará, Fortaleza, Ceará, Brazil. Email: rsouza@ufc.br