In many physical systems, it is difficult to obtain a model structure that is highly nonlinear and complex. However, models are usually linear, but not suitable in such form to model processes because they contain a significant number of simplifying hypotheses which are insufficient for the design of reliable controllers. The absence of robustness with respect to system parameters does not ensure the performance specifications of the control system knowing that the nominal parametric state rarely corresponds to the real one. For these raisons, it is beneficial to use a specific technique to characterize accurately system dynamics in an entirely uncertain environment. In this work, we present an approach to approximate and validate over a large operating range the dynamic behaviour of a Three Tank System benchmark based on a radial basis function neural network (RBFNN). The proposed RBFNN is applied to solve the parametric-identification problems for nonlinear and complex system by using a modified DIRECT algorithm to search the network parameters. The learning algorithm is developed by combining the DIRECT algorithm and a linear regression for fast convergence. Different experimental results have been performed to show the effectiveness of the RBFNN model to emulate the dynamic behaviour of the nonlinear and complex system under different situations