A novel RK4-Hopfield neural network for power flow analysis of power system

ABSTRACT

This paper presents a novel Runge–Kutta (RK4) based modified hopfield neural network (MHNN) for solving a set of non-linear transcendental power flow equations of power system. The proffered method is a Lyapunov based energy function approach to minimize real and reactive power mismatches of the system. A set of non-linear differential equations derived from energy function, describing the dynamical behavior of HNN is framed for solving Power Flow equations. These dynamic equations of the network are solved by RK4 method to deduce the unknown variables of the system. The feasibility of proposed method is tested on 5-bus, IEEE 14-bus, 39-bus and 57-bus test system. The analytical equation describing the behavior of MHNN is coded in MATLAB software. The results obtained reveal that the suggested method gives accurate solution and reduces the computational complexity than conventional Newton Raphson (NR) method. The sensitivity analysis is also tested for change in R/X ratio of the system, initial conditions and loading of the system. The proposed method is robust for above specified changes and involves less computational effort. To prove the applicability and consistency of projected method, IEEE 118-bus system has been tested. The power flow solutions found through proffered method are compared with solutions obtained from numerical approaches in order to validate the proposed approach. Moreover, the stability of the system is studied in Lyapunov sense of notion which assures converged solution of proposed method.

Keyword: Power Flow Analysis (PFA); Modified Hopfield Neural Network (MHNN); Newton Raphson (NR) method; Iwamoto; Euler; 4th order Runge–Kutta (RK4) method