On-Line Transient Stability Analysis of a Multi-Machine Power System Using the Energy Approach

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(ABSTRACT)

This thesis investigates and develops a direct method for transient stability analysis using the energy approach [1] and the Phasor Measurement Units (PMUs). The originality of this new method results from a combination of a prediction of the post-fault trajectory based on the PMUs and the Transient Energy Function of a multimachine system. Thanks to the PMUs, the weakness of the direct methods, which is the over-simplification of the generator model, is overcome. This new method consists of fitting a curve to the data of the post-fault path provided by PMUs and identifying the controlling unstable equilibrium point (c.u.e.p.). Two second-order linear models have been estimated and evaluated from a prediction viewpoint. These are a polynomial function and an auto-regressive model. These parameters have been estimated by means of the least-squares estimator. They have been compared to the model proposed by Y. Ohura et al. [6], which has been upgraded into an iterative algorithm. The post-fault trajectory is predicted until the exit point located on the Potential Energy Boundary Surface (p.e.b.s.) is reached. In order to detect with efficiency this exit point and to find the c.u.e.p., it is proposed a combination of the so called "Ball-Drop" method [22] and an improved version of the Shadowing method. These combined procedures give accurate results when they are compared to the step-by-step method, which directly integrates the differential equations using a fourth-order Runga-Kutta method. The simulations have been carried out on a 3-machine system and on the 10-machine New-England power system.

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