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Development of an Electromagnetic Transient Analysis program for Power System Simulations – XTAP

Yohei Tanaka, Rikido Yonezawa, and Taku Noda
Energy Innovation Center, CRIEPI
Kanagawa, Japan

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Abstract

Electromagnetic transient (EMT) simulation programs, which calculate transient phenomena in power systems at waveform level, have been used for simulations of abnormal voltages, abnormal currents, and assessment of power quality in power systems. In recent years, they are also used in studies of power systems including power electronics converters such as power conditioning systems (PCSs) for solar and wind power generation, high voltage direct current (HVDC) converters, and flexible AC transmission system (FACTS) devices. To this end, Central Research Institute of Electric Power Industry (CRIEPI) has been developing an EMT simulation program called XTAP (eXpandable Transient Analysis Program). XTAP has the following features:

(i) The 2-Stage Diagonally Implicit Runge-Kutta (2S-DIRK) method is used for the numerical integration process. It does not generate numerical oscillation when an inductor current or a capacitor voltage is discontinuously changed. The widely-used trapezoidal method is prone to this numerical oscillation.
(ii) Fast simulation speed is achieved by parallel computation utilizing multi-core CPUs.
(iii) Comprehensive electrical and control elements and power system component models are equipped and can readily be used.
(iv) XTAP has a powerful graphical user interface (GUI). It allows the user to intuitively set up a complicated simulation case and view results.
(v) XTAP has been and is used for existing HVDC and frequency converter projects by electric power companies in Japan. It is also expected to be used for simulations to realize smarter distribution systems.

EMT simulation programs are often used for obtaining the optimal values of circuit and control parameters. If the optimal values were searched for by repeatedly performing EMT simulations by trial and error, it would be tedious task. To solve this problem, we have been developing an EMT-simulation-aided optimization technique, which automates this tedious process by combining an optimization algorithm and EMT simulation using XTAP.

In this poster presentation, the overview of XTAP is given, and an application of the EMT-simulation-aided optimization technique to the design of the AQR controller of a STATCOM is illustrated.