Mixed phasor and time domain modelling of AC networks with changeover management

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Simulation studies on AC electric networks may comprehend periods of quasi-stationary operation and rapid transients. The adoption of a phasor-based approach results in high simulation efficiency, but is limited to the first of the two situations above, while for the second, time domain models are required. For system studies where both situations have to be simulated, a modelling paradigm is thus required that can join the two approaches in all the described components, and by which the simulator of an entire network can be endowed with the capability of moving back and forth from a phasor to a time domain system description automatically, taking care of the proper re-initialisations when necessary.

In this paper we propose a possible solution, structured into a *component-level* part and a *system-level* one. This allows to preserve the object-oriented nature of the constructed models, even though the automatic changeover from phasors to time domain mode is a decision to be taken at the overall system level. For that particular purpose, we introduce a mechanism based on continuous-time filters, that allows to exploit the capabilities of variable-step solvers in a view to efficiency, and limits the number of changeover-generated state events to the bare necessary.

As a result of the design sketched out above, the additional effort required on the part of the analyst for using the proposed mixed modelling paradigm is reduced to a minimum, and – which is equally important – requires a really minimal (if any) and easy to understand knowledge of the underlying mechanism.

To prove the viability and usefulness of the proposed ideas, we put them to work, and as a consequence we present the first *nucleus* of a Modelica library designed along them. We also show some simulation examples to support the validity and practical convenience of the proposal.

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