Modelling of Electrical Power Systems with Dynamic Phasors in Modelica

<Tao Yang> <Serhiy Bozhko> <Greg Asher>
<University of Nottingham>
< University Park, Nottingham, NG7 2RD, UK >
<Tao.Yang, Serhiy.Bozhko, Greg.Asher@nottingham.ac.uk>

The More-Electric Aircraft (MEA) has been identified as the major trend of aircraft. Compared with conventional aircraft, the Electrical Power System (EPS) in MEA is a more complex system with increased numbers of power electronic converters (PEC) and electrical loads. In order to ensure the over-all performance of the EPS, it is essential to study the aircraft EPS at the system level. However, due to the switching behaviour of power electronic devices, it is very time-consuming and even impractical to simulate a large-scale EPS with some non-linear and time-varying models. In this paper, the Dynamic Phasor (DP) technique is introduced to model the EPS [1]. The DP is in nature some time-varying Fourier coefficients. Compared with traditional phasors, the DP can be used not only for steady-state studies, but also for transient studies.

A model library based on DP concept has been built. This paper summarizes the DP model library developed in The University of Nottingham for accelerated simulation studies of the aircraft EPS. The developed library includes Synchronous Generators, Controlled Rectifier Units (CRU) [2], Auto-Transformer Rectifier Units (ATRU) [3] etc. A twin-generator system based on the More-Open Electrical Technology (MOET) architecture is studied using developed DP models. The ABC models (Models in three-phase coordinates with switching behaviour) and DQ0 models (Averaging model in the dq frame) are used for comparative studies. The efficiency and the accuracy of the DP model are demonstrated through comparison of the simulation results with ABC and DQ0 models, under both normal and abnormal operation conditions.

References

[1] A. Emadi, "Modeling of power electronic loads in AC distribution systems using the generalized State-space averaging method," *Industrial Electronics, IEEE Transactions on*, vol. 51, pp. 992-1000, 2004.

[2] Y. Tao, S. Bozhko, and G. Asher, "Modeling of active front-end rectifiers using dynamic phasors," in *Industrial Electronics (ISIE), 2012 IEEE International Symposium on*, 2012, pp. 387-392.

[3] S. B. Tao Yang, Greg Asher, "Modeling of An 18-pulse Autotransformer Rectifier Unit with Dynamic Phasors," *SAE 2012*, 2012.