RWTH AACHEN UNIVERSITY

E.ON Energy Research Center
ACS | Institute for Automation of Complex Power Systems

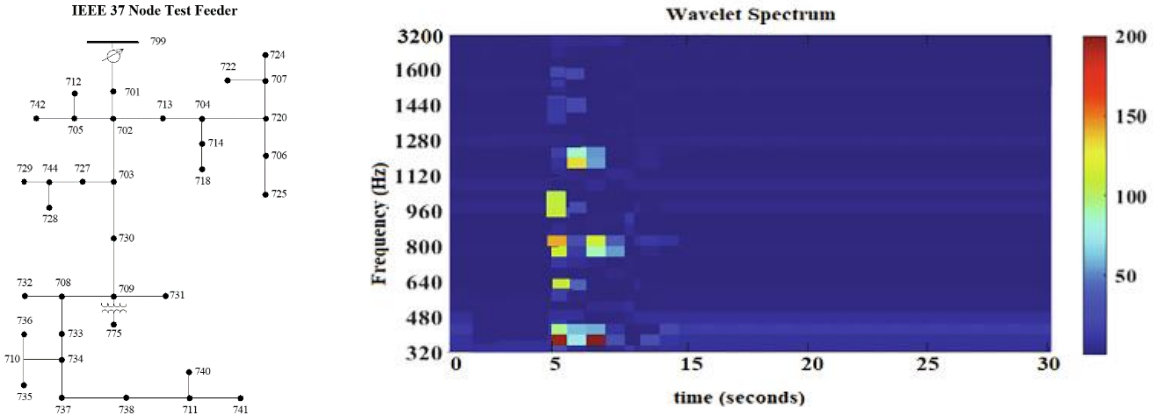
Bachelor/Master Thesis:

Time-adaptive simulation using Digital Signal Processing techniques

Context:
The simulation of modern power systems requires the accurate representation of grid dynamics emerging due to additionally installed components such as distributed energy resources with low-inertia characteristics. Besides, large-scale simulations of scenarios with a high number of grid nodes allow to understand specific dynamic phenomena and to include as well lower voltage levels, but they are computationally more expensive.

The solution approach of most of the state-of-art simulators base is the solution of differential algebraic equations (DAE). The solver uses discrete-time techniques to approximate the solution, and one of the most important parameters to select is the size of the timesteps (as it is crucial for the representation of the grid dynamics). There is a strong link between the timestep size and both the accuracy and the computational load. Therefore, a study on the possibilities for the usage of existing and novel techniques is suitable.

Hence, the thesis focus is on the evaluation of the transients of fault events in the nodes using digital signal processing techniques (e.g. discrete wavelet transforms), to provide a basis for comparison using different timesteps for future co-simulation and hybrid simulation efforts.



Wavelet spectrum in an electrical disturbance (Gupta, 2021)

Tasks:
The scope of the thesis can be adapted to be suitable for bachelor or master thesis. The key elements of the work will be:

- Use EMT dynamic simulation of a simple RLC circuit (the circuit basic configuration can be provided) or other simple electrical scenario applications.
- Assessment of transient at specific circuit nodes in fault events configuring the circuit parameters and select candidates for the method.
- Apply discrete wavelet transform (DWT) to evaluate the frequency composition of the fault transients in the selected nodes
- Evaluate which nodes in the network are best for the method (using the simplified benchmark network) applying DWT to evaluate the transients
- Assessment of the performance of selected families of wavelets considering accuracy, computation time and time-frequency selectivity

Basic knowledge of Python is required. Experience in power system modelling and simulation, Jupyter Notebooks or C++ is desirable.

If you have interest in the thesis topic, please send an email to the contact below stating your motivations. Please include as an attachment your CV and current grades.

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