

# Comprehensive models for the non-linear devices and their influence to the distribution networks

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## Summary

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*This thesis has a goal to research the properties and behavior of the modern power electronic devices, connected to the AC grid, in order to determine their effects to the distribution network power supply quality and possible means to increase to the non-linear devices' hosting capacity of the distribution networks.*

Research field:	Electrical power engineering and mechatronics
Supervisor:	Dr. Lauri Kütt
Availability:	This position is available.
Offered by:	School of Engineering Department of Electrical Power Engineering and Mechatronics
Application deadline:	Applications are accepted between June 01, 2020 00:00 and July 03, 2020 23:59 (Europe/Zurich)

## Description

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Local renewable sources, especially solar but also small-power wind, require use of power electronic units for converting the power to be supplied to the distribution networks, or for usage in household. Especially related to connection to the public AC distribution networks, the inverter devices are also responsible for defining the indexes of power quality, for example level of voltage and voltage distortions.

Power electronic converters are non-linear sources, meaning that they produce a distorted AC voltage and current. Modern loads used in households also incorporate power electronics and have also non-linear characteristics. The distorted load currents and the inverter's ability to supply the different distortion components will need to be investigated to determine the total magnitudes and effects of the distortions. This is needed to verify that the distribution network can support the connection of net-zero energy buildings.

### **The main tasks of the research include:**

1. Elaboration of empirical characteristics for the residential consumer load devices. The total load distortions of the household will be analyzed down to device parameters' level. Furthermore, for assessing the harmonic interactions of the loads, the model has to take into account the possible effects to the devices from network varying impedance and variations in the supply voltage distortions.
2. Renewable energy converters harmonic modeling  
Inverters for the domestic renewable electric production sources will be studied to find out their performance depending on the supply voltage distortions and also load current distortions. This will be analyzed on different power levels and inverter performance models with expected weather data will be elaborated.
3. Modeling the inclusion of high levels of presence of the renewable power sources. The task includes investigations of different buildings to present their estimated distortion effects to the power distribution networks. Goals of the models here are to estimate the supply voltage distortions for a larger number of inverter units connected to the distribution network.

Within the PhD studies, the candidate will present his/her work in international conferences (funded by DoRa or similar programs) and publish journal papers required to complete the thesis.



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