

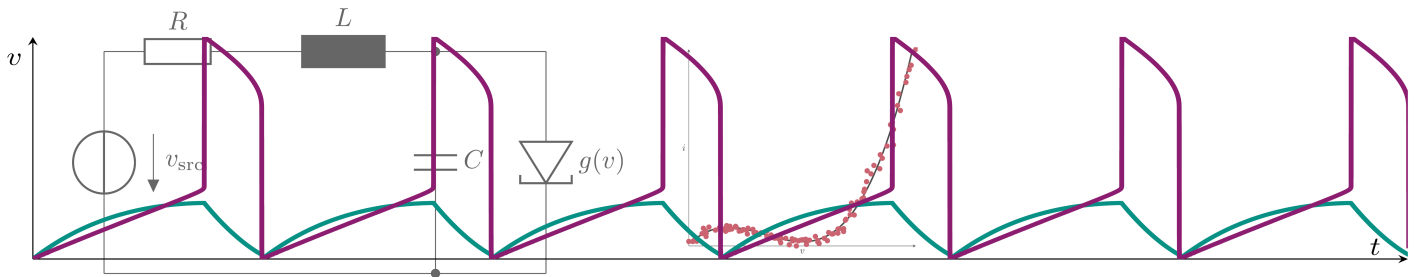
# Circuit simulation with a discontinuous Galerkin based data-driven modified nodal analysis solver



TECHNISCHE  
UNIVERSITÄT  
DARMSTADT

M.Sc. thesis

Electrical Engineering / Computational Engineering  
Start: Winter semester 2022/23



## Description

An electrical circuit can be fully described through **Kirchhoff's circuit laws** and the employed **lumped elements**. Kirchhoff's circuit laws are directly derived from Maxwell's equations and thus considered to be exactly known. Contrarily, the behaviour of the lumped elements is at first only known through measurements. In conventional approaches, a model that fits best to the available measurement data must be derived. This is typically accomplished by means of empirical modeling approaches, which however cannot represent the elements' behaviour exactly, introduce **epistemic uncertainties**, and can be difficult to apply for sophisticated elements.

Data-driven solvers dispense with empirical models by solving the underlying problem directly on the measurement data instead. Therefore, errors arising from the modelling process as well as epistemic uncertainties are avoided and the data-driven solutions can be considered as **assumption-free**.

**The aim of this work is to develop a data-driven modified nodal analysis solver that employs a discontinuous Galerkin formulation to solve along the time scale.**

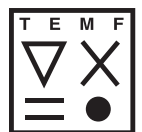
## Tasks

- Literature study on data-driven solvers and discontinuous Galerkin formulations
- Implementation of a discontinuous Galerkin solver for the conventional problem formulation
- Full implementation of a discontinuous Galerkin data-driven solver for ODEs
- Numerical analysis of the developed method on several electrical circuits

## Prerequisites

Moderate/strong knowledge in finite elements, experience in PYTHON programming, interest in numerical methods.

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