



Combined term paper and Bachelor's thesis or Master's thesis **Automated adaptation of multiple shooting methods**

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Numerical simulations play an increasingly important role in engineering and science. In dynamic systems, periodic solutions are of interest in many cases since they can occur in various engineering applications.

For the numerical approximation of such solutions the MATLAB Toolbox **CoSTAR** (*Continuation of Solution Torus AppRoximations*) is developed by the working group. Embedded in a path-following / continuation algorithm, this toolbox allows the computation of periodic solutions and their stability behaviour as a function of a system parameter. Various numerical methods can be selected to approximate a solution and to compare results. The toolbox is already published on GitHub and will be further improved and extended in the future.

An approximation method available in **CoSTAR** is the multiple shooting method. This method computes a periodic solution by numerical time integration, where the solution period is divided into N intervals. Correspondingly, N separate time integrations are performed. To minimise the computational effort, N should be as small as possible, but this may cause the algorithm to abort if the solution is unstable. To ensure the convergence of the numerical solver as well as a reliable and efficient path continuation, it is planned to automatically adapt the number of integration intervals N .

Work steps:

- Familiarisation with the theory of path continuation, multiple shooting methods and stability computation as well as the **CoSTAR** toolbox
- Literature research on adaptive multiple shooting methods
- Programming of a multiple shooting method with automatic adaptation
- Implementation of the adaptation algorithm into **CoSTAR**

Your skills:

- Ability to work independently and responsibly
- Basic knowledge of programming (ideally MATLAB)
- Good to very good mathematical skills (ideally numerical analysis)

You may look forward to:

- Develop your programming skills as an essential engineering skill
- Complete your thesis in an open team as well as in a friendly and relaxed working environment
- Sufficient induction phase and excellent support with regular meetings
- Working at the institute or fully mobile

Are you interested or do you have any questions?

Then please contact us and send an email to technische-dynamik@uni-kassel.de.