



Combined term paper and Bachelor's thesis or Master's thesis Implementation of collocation methods for the computation of (quasi-)periodic solutions

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Numerical simulations play an increasingly important role in engineering and science. In dynamic systems, not only periodic but also so-called quasi-periodic solutions are of interest. These solution types can occur in aircraft engines, wind turbines or as orbits in space.

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 (quasi-)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 not yet available in the **CoSTAR** toolbox to numerically solve the underlying differential equations is the collocation method. This method approximates the solution by piecewise polynomials that satisfy the differential equations at the so-called collocation points exactly. Since the comparison of different methods and their solutions is one of the central aspects of **CoSTAR**, it is planned to implement the collocation method into the toolbox.

Work steps:

- Familiarisation with the theory of path continuation, collocation methods and quasi-periodicity as well as the **CoSTAR** toolbox
- Programming of a simple example to compute periodic solutions using collocation
- Implementation of the collocation method for periodic solutions into **CoSTAR**
- Extension of the methodology for calculating quasi-periodic solutions

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.