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Exercise Sheet 5

Presentation during exercises in calendar week 25

The code can only be compiled and run on the CIP Pool! Don't forget to run `"source .bashrc"` after logging in.

In this sheet we solve different Boundary Value Problems (BVP) using the Multi Shooting Implementation Muscod II. A skeleton file is provided. You need to define your problem in the source file (SRC/bvpXX.cc) and the DAT file (DAT/bvpXX.dat). Build your files in the build directory and run the code using:
`moscod "name_of_DAT_file"`

Exercise 5.1 – Single Shooting Solve the following ODE for different boundary conditions:

$$\ddot{x} + x = 0 \rightarrow \begin{bmatrix} \dot{x} \\ \dot{v} \end{bmatrix} = \begin{bmatrix} v \\ -x \end{bmatrix} \tag{1}$$

Boundary Condition 1:

$$x(0) = 0$$
$$x(\frac{3\pi}{2}) = 1$$

Boundary Condition 2:

$$x(0) = 0$$
$$x(\pi) = 0$$

Boundary Condition 3:

$$x(0) = 0$$
$$x(\pi) = 1$$

What is the general solution to the ODE? What do you expect for the different boundary conditions? What does the optimization code return?

Exercise 5.2 – Multiple Shooting Solve the following ODE for different boundary conditions:

$$\begin{bmatrix} \dot{x} \\ \dot{v} \end{bmatrix} = \begin{bmatrix} v \\ \lambda_1 \cdot sinh(\lambda_1 \cdot x) \end{bmatrix} \tag{2}$$

Boundary Condition:

$$x(0) = 0$$
$$x(1) = 1$$

Vary the λ_1 parameter in the range of 1 to 20. How does the function change? Is Muscod always able to solve the BVP? How do you need to adjust your DAT file?