KUTAISI INTERNATIONAL UNIVERSITY

Numerical Programming

Ramaz Botchorishvili

Kutaisi International University

Final Project

Final project

Problem 2.1

Solve any two from the list:

1. Hit a ball to fixed target (15 points).
2. Intercept a moving ball (15 points).
3. Sturm-Liouville problem (15 points).

Tasks

- Formulate algorithm, explain your approach in written.
- Describe properties of numerical methods in written.
- Develop test cases and demonstrate validity of your results.
- Upload all necessary files, including
  1. Presentation file
  2. Code
  3. Test data and their description
- Using shooting method and ball motion equation is compulsory

Hit a ball to fixed target

Components

- Input: Image of randomly scattered balls.
- Task: Throw ball and hit balls on the image one after another
- Output: Animation corresponding to the task description
- Test: Test case description
- Methodology: should contain problem formulation, including equation with initial and boundary condition, method of solution, algorithm

Intercept a moving ball

Components

- Input: part of a video of a moving ball
- Task: Throw a ball and intercept moving ball
- Output: Animation corresponding to the task description
- Test: Test case description
- Methodology: should contain problem formulation, including equation with initial and boundary condition, method of solution, algorithm

Sturm-Liouville Problem

Components

- Input: Sturm-Liouville problem, see examples below
- Task: find first 8 eigenvalues and eigenfunctions
- Approach: approximate vanishing or singular coefficients
- Output: visualisation of eigenvalues and eigenfaunctions
- Test: Test case description
- Methodology: should contain problem formulation, including equation with initial and boundary condition, method of solution, algorithm

Example, Sturm-Liouville Problem

$$-\frac{1}{2}\left(\cos^4(x)\frac{d^2u}{dx^2}+\frac{\cos^3(x)\cos(2x)}{\sin(x)}\frac{du}{dx}\right)+\left(m^2\frac{\cos^2(x)}{2\sin^2(x)}-\frac{\cos(x)}{\sin(x)}\right)u=\lambda u$$

$$u(0)=0 \quad u(\frac{\pi}{2})=0$$

Final project

Important Notice

- Updated version with assessment criteria will be published before finals.
- The project is assigned 0 points if:
  - Any of the requested and/or necessary file is missing.
  - Submitted results are not reproducible.
  - Student cannot apply his own code for the input data provided by TA or instructor.
- Submission deadline: will be aligned with the schedule of final exams. See corresponding assignment in Teams.