LiqSim

December 11, 2024

Authors and version

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Version: prod: 0.0.1.1

Introduction

Project purposes and description of the modeled physical phenomenon

The movement of surface of liquid counted by shallow water equations

Used tools

- *Python* 3.11
- *matplotlib* 3.9.3
- *scipy* 1.14.1
- *sympy*
- *numpy* 2.1.3
- *LaTeX*
- *git*2.47
- *https* : *//github.com/*
- *GitHubDesktop*
- *PyCharm* 2024.3

General description of the project and possible alternatives

Simulating of liquid's surface movement will be described with shallow water equations:

$$\frac{\partial \eta}{\partial t} + \frac{\partial(\eta v_x)}{\partial x} + \frac{\partial(\eta v_y)}{\partial y} = 0$$

$$\frac{\partial(\eta v_x)}{\partial t} + \frac{\partial}{\partial x}(\eta v_x^2 + \frac{1}{2} g \eta^2) + \frac{\partial(\eta v_x v_y)}{\partial y} = 0$$

$$\frac{\partial(\eta v_y)}{\partial t} + \frac{\partial}{\partial y}(\eta v_y^2 + \frac{1}{2} g \eta^2) + \frac{\partial(\eta v_x v_y)}{\partial x} = 0$$

Where η is the total fluid column height and vector $\overrightarrow{v} = (v_x, v_y)$ is the fluid's horizontal flow velocity, averaged across the vertical column. With this equations being solved, surface of fluid could be represented.
Will be represented by making liquid's surface class, plot and animation maker classes. Also with the function of surface object. All would be united with solved equations. Example: https://www.youtube.com/watch?v=IVXkm-no4ro
WARNING: must ask about numeric and symbolic ways to find solutions.
ATTENTION: Physical and mathematical model could be corrected with adding more features if possible

Requirements

Functional requirements

- animation of movement of surface of liquid in time
- animation of velocity and acceleration fields in time
- getting velocity and acceleration field in exact time
- some features could be added

Non-functional requirements

- input start conditions in separate window
- output start conditions with result animations and plots
- getting an .exe file. Optional: getting an android release
- some features could be added

Work shedule and deadline

Days	Aim
Week 1 (4.XII.2024 - 11.XII.2024)	Making theoretical model. Creating class for water surface
Week 2 (11.XII.2024 - 18.XII.2024)	Find ways to find solutions and test them. Create class for animation maker
Week 3 (18.XII.2024 - 25.XII.2024)	Connect animation maker and surface object. Test it with some functions
Week 4 (25.XII.2024 - 01.I.2025)	Add velocity and acceleration fields methods to animation maker. Optional: create methods to save surface, velocity and acceleration fields as images in current time
Week 5 (01.I.2025 - 08.I.2025)	Create class for interactive with user and connect it to the program
Week 6 (08.I.2025 - 15.I.2025)	Final features. Optional: creating .exe and .apk distributives
Week 7 (15.I.2025 - 22.I.2025)	Final testing and finishing
22.I.2025	DEADLINE & presentation

All versions could be found in repository
https://github.com/Uki-coder/LiqSim

Literature

[1] *https://docs.python.org/3.11/*
[2] *https://matplotlib.org/stable/*
[3] *https://docs.scipy.org/doc/scipy/*
[4] *https://numpy.org/doc/stable/index.html*
[5] *https://en.wikipedia.org/wiki/Shallow_water_equations*