Differentiable Stable Fluid Solver using TensorFlow

This project aims to implement a stable fluid solver [1] using machine learning library, TensorFlow[1], such that the solver is differentiable and can be integrated in training process. This topic requires good understanding of partial differential equations, in particular, the Navier-Stokes equations that model a variety of fluid flows. Moreover, it requires nice programming skills (particularly in Python). You should be able to make good use of TensorFlow.

Objectives

In this project, you will implement a smoke simulation solver using math APIs of TensorFlow. To begin with, you will first implement a 2D version solver. The implementation will require a good understanding and use of TensorFlow APIs. For the 2D version, you should be able to visualize simulation results with simple visualization tools such as matplotlib. Once you achieve the 2D version, you should extend it to 3D. To this end, the core part will not change much, but, you should be able to export your simulation results using OpenVDB. The results should be loaded from the external renderer tool such as Blender. You are responsible to figure out how to use the open-source libraries for the given tasks.

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References

[1] Jos Stam. 1999. Stable fluids. In Proceedings of the 26th annual conference on Computer graphics and interactive techniques (SIGGRAPH '99). ACM Press/Addison-Wesley Publishing Co., USA, 121–128. DOI:https://doi.org/10.1145/311535.311548

1 https://www.tensorflow.org/