



Thesis Projects (MIE498 H/Y) 2018–2019

Title/Topic: GPU based particle image velocimetry

Description:

Particle Image Velocimetry (PIV) is a powerful and widely used tool for studying a multitude of fluid flows. However, despite the many advantages of PIV, the algorithm used is computationally expensive, often limiting the possible size of datasets. This can call into question the validity of the statistical convergence of the data, which is particularly important for resolving higher order statistics needed in turbulent flows. In prominent PIV studies, generally small datasets, or larger datasets with small fields of view are used. PIV has been shown to be massively accelerated by GPU computing. However, some drawbacks still exist. Most of the software is not open source, therefore to use a GPU accelerated algorithm means either developing in house code, or purchasing a commercial license. Commercial software has the added drawback that the details of the algorithm are unknown to the user, making it impossible to know exactly how the data is being processed. Additionally, most PIV software is platform dependent, generally running only on Windows, which excludes the possibility of running high performance systems such as supercomputing clusters.

To fully utilize the power of GPU acceleration, an open-source, cross-platform, GPU-accelerated PIV algorithm is needed. As a basis for development, OpenPIV is a popular, open-source PIV software package written in Python. Since it is written in Python, OpenPIV can run on essentially any platform and operating system, from small embedded systems using to large supercomputing clusters, and will likely be supported for the foreseeable future, making OpenPIV an excellent option to develop. This aim of this project is to extend the OpenPIV algorithm to utilize GPU acceleration, enabling the realistic collection of larger PIV datasets, and ultimately increasing the statistical accuracy of the measurements. The algorithm will be rigorously validated with standard methods using synthetically generated images as well as experimental data. The tools developed in this project will be included with the OpenPIV distribution, and freely available for anyone to use.

It is useful to have a background in Multithreading and Python and benefit from a current code that is already implemented on the SOSCIP GPU cluster.

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