pFIRE a parallel Framework for biomedical Image REgistration

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1. Abstract

Image registration is the process that determines the mathematical function that maps a medical image of an anatomical region subject to a deformation/translation, to a reference image. It can be applied to a range of problems. E.g. to; align diagnostic images of a patient taken at two different time steps, identify an anatomical contour or discrete mesh on the patient image by mapping the golden standard one from an image of a reference patient [1,2].

In some cases, in order to achieve meaningful diagnoses in a useful timeframe, it is necessary to process a large number of very high-resolution images to capture deformations at the correct scale. The computation of 3D strains in bones subject to load using the Digital Volume Correlation algorithms [3] is presented as a computational demanding registration problem requiring the use of HPC resources. This paper presents the parallel Framework for Image REgistration (pFIRE) which implements the registration algorithm developed by [1, 2] targeting HPC architectures. The aim of the software is to achieve good scalability and accelerate execution time of the registration algorithm. pFIRE is open source and follows the best practices in software dev5elopment and FAIR principles [4]. It relies on advanced numerical libraries (PETSc [5]), is distributed and is also containerised (Docker, Singularity) to assist in deployment in Cloud-HPC systems and on desktop machines.

2. References

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