Research Project

Acceleration of non-rigid image registration with Tensor Cores

Jonathan LEVY

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Cursus

About me

- Jonathan LEVY
- MSc student in Computer Science
- Engineering background

Cursus Summary

- *Classe Préparatoire PTSI/PT**
- Ecole Normale Supérieure de Rennes (BSc, Master in Teaching)
- *Agrégation* in Engineering, CS track
- MSc Embedded Systems, TU Delft

Current work

Since September 2019:

GASAL2 : GPU-accelerated library for DNA alignment

Languages C/C++ and CUDA

Algorithm Smith-Waterman - optimal alignment for short pair

Goal Speed-up the *Burrough-Wheeler Aligner, "BWA"* by 1.33x

https://github.com/j-levy/GASAL2

https://github.com/j-levy/bwa-gasal2 ← private repository

https://jlevy.weblog.tudelft.nl ← weekly logs

Acceleration of non-rigid image registration with Tensor Cores

- Image registration: aligning a *floating* image with a *reference*.
- *Non-rigid*: various deformations allowed
- Use Next-gen GPU for acceleration

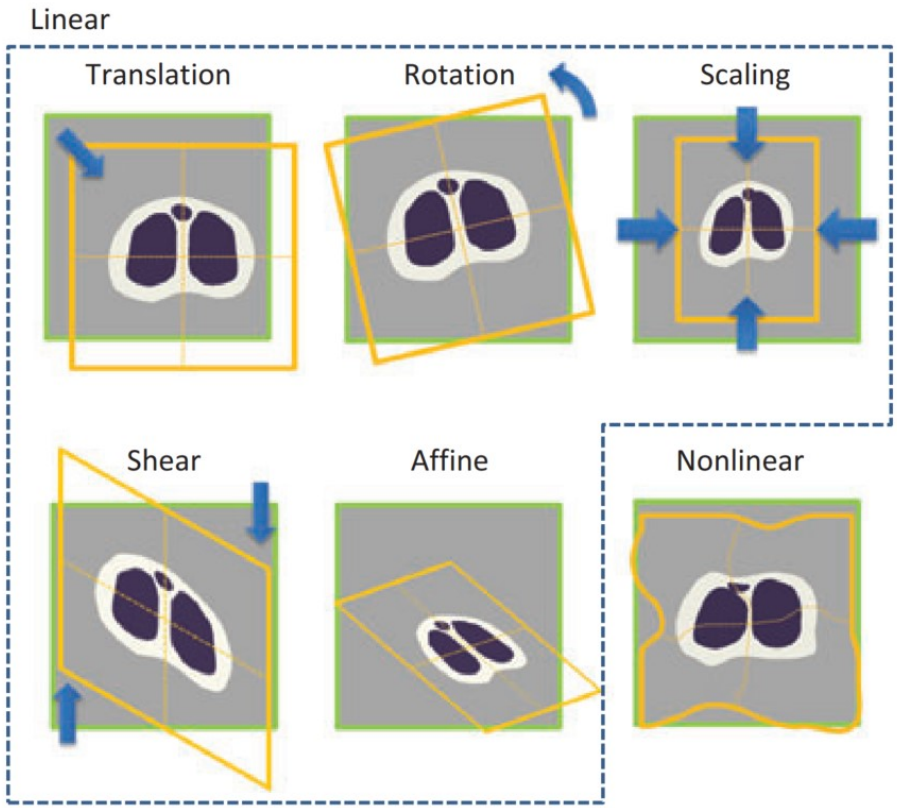

Figure 1: Different types of deformation.

Acceleration with Tensor Cores

Recent NVIDIA GPUs
(Volta Architecture)

- Refined scheduler
- New memory scheme
- Tensor Cores

Tensor Cores:

WHAT Matrix-matrix multiplication

HOW Mixed precision (precision loss)

WHY Originally, deep learning

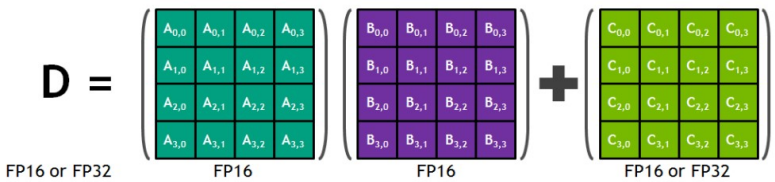

Figure 2: Operation done by a Tensor Core

Could be used to calculate:

- B-Splines (quantify smoothness)
- Entropy (quantify similarity)

And other various modern optimizations

Work proposal

Integrate in existing work:

1. Accelerate B-Splines calculation using tensor cores
2. Accelerate entropy calculation with tensor cores too
3. Quantify precision loss
4. Allow for precision refining if needed
5. Send results for rendering (visual output)

Why Japan?

- Leading role in HPC
- Culture,