Gaussian Process Deconvolution for Perfusion Imaging
Evaluation of the usage of distributed and parallel computing:
Using GPGPU to achieve a fast and accurate approach

Fan Zhu[1,2], Jano van Hemert[1,2], David Rodríguez González[1,2]and Trevor Carpenter[3]

[1] SINAPSE [2] National e-Science Centre, School of Informatics, University of Edinburgh. [3] SFC Brain Imaging Research Centre, Division of Clinical Neuroscience, University of Edinburgh.

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Perfusion for Bring Imaging

Deconvolution is used in perfusion imaging to obtain the Impulse Response Function(IRF) that is then used to create parametric maps of relevant haemodynamic quantities such as Cerebral Blood Flow (CBF), Cerebral Blood Volume (CBV) and Mean Transit Times(MTT).

Time

VOF Curve

VOF

Time 1   Time 2   Time 3   Time n

Time Line
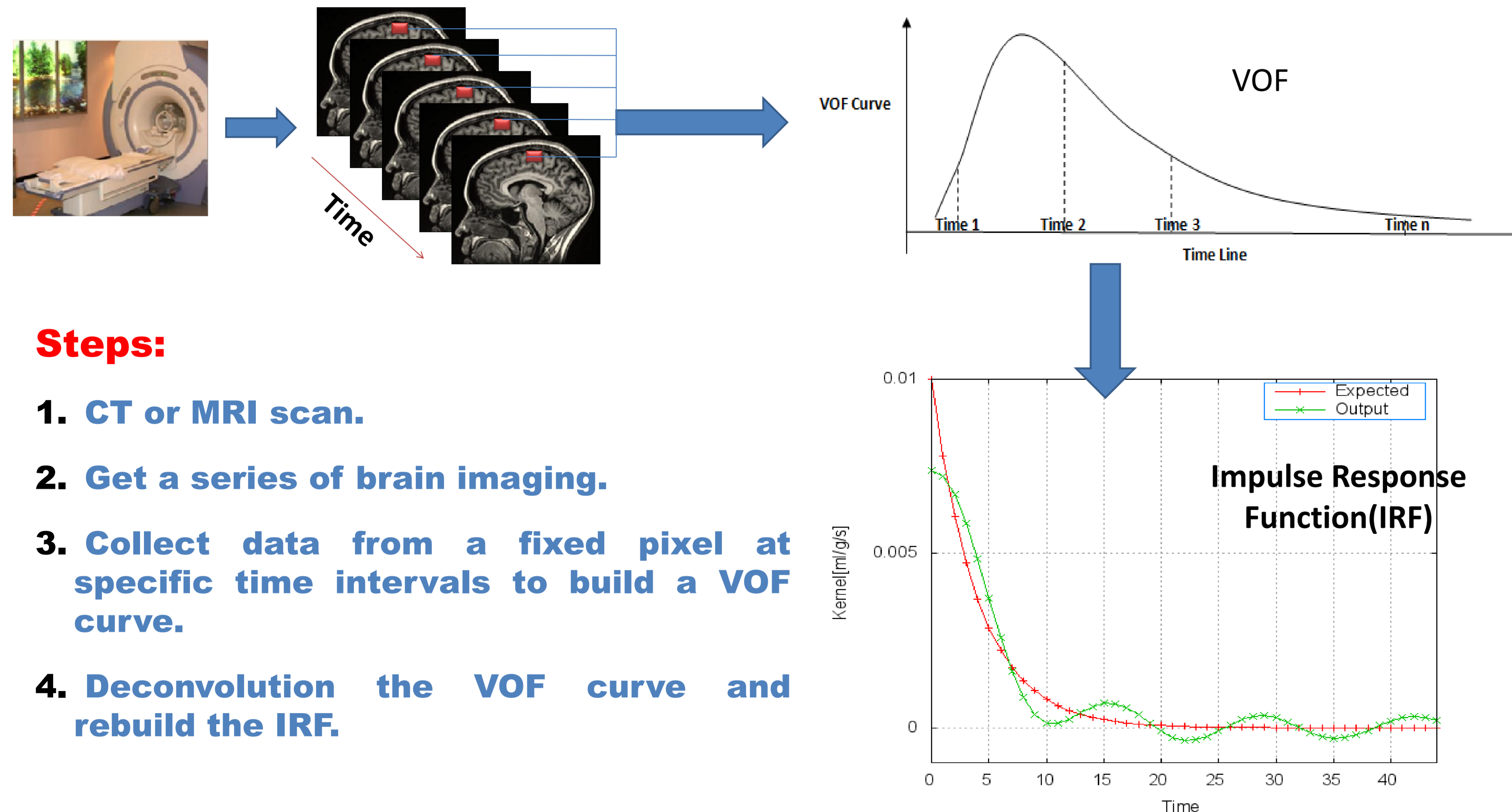
Steps:

1. CT or MRI scan.

2. Get a series of brain imaging.

3. Collect data from a fixed pixel at specific time intervals to build a VOF curve.

4. Deconvolution the VOF curve and rebuild the IRF.

Impulse Response Function(IRF)
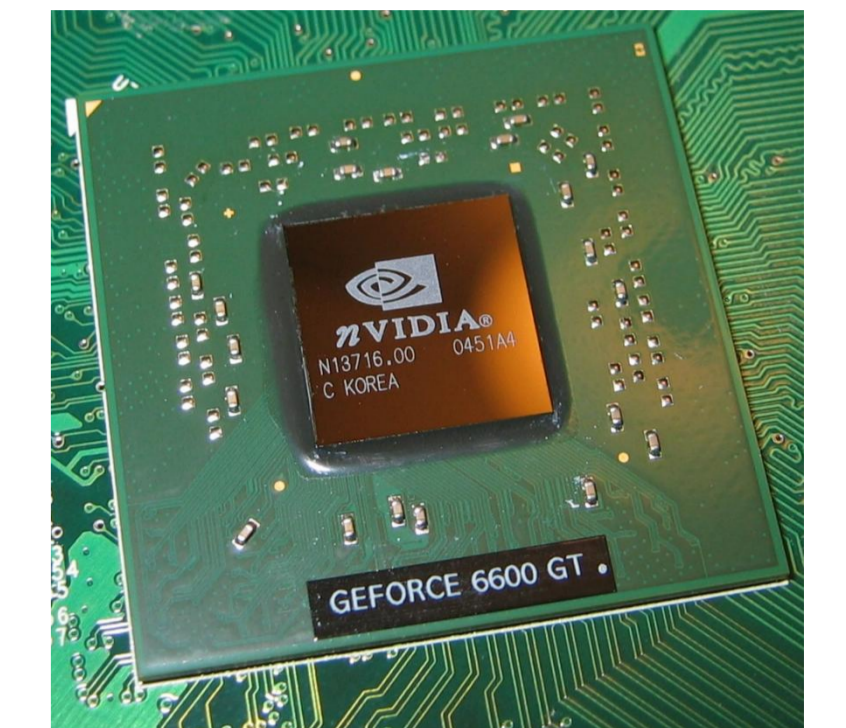
Kernel[ml/g/s]

Expected
Output

Time

Deconvolution Methods

In previous studies, a popular method to achieve this is Singular Value Decomposition (SVD), but it has been shown that for MRI, Gaussian Process for Deconvolution (GPD) is comparable to SVD when determining the maximum of the IRF, and superior estimating the full IRF. Furthermore, it clearly outperforms SVD when the signal-to-noise ratio improves.
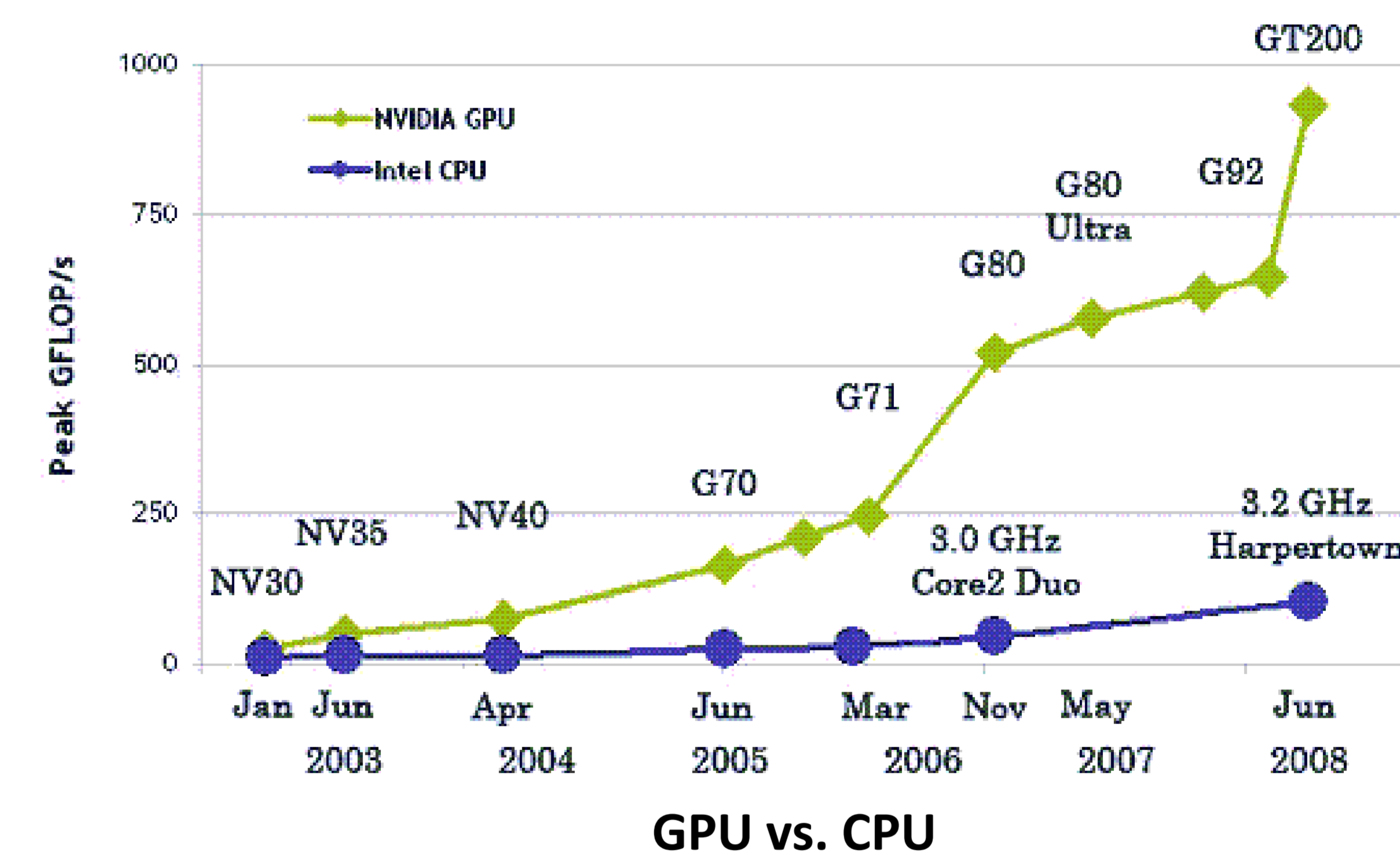
In this project, we aim to improve the results of deconvolution methods by applying new combinations of parameters and combining it with state-of-the-art approaches for denoising.

GPGPU

General-Purpose computing on Graphics Processing Units (GPGPU) is a technique of using a graphics processing units(GPU) to handles computation in applications traditionally handled by CPU. It is a popular approach that uses parallelization to speed up computation tasks.

NVIDIA GEFORCE 6600GT GPU

Peak GFLOP/s

NVIDIA GPU
Intel CPU

GT200

G92
G80 Ultra
G80
G71
G70
NV40
NV35
NV30

3.2 GHz
Harpertown

3.0 GHz
Core2 Duo

Jan Jun   Apr   Jun   Mar   Nov   May   Jun
2003   2004   2005   2006   2007   2008

GPU vs. CPU

Why GPGPU

• As thousands of pixels need to be deconvoluved, the calculation over all these pixels takes minutes or even hours when performed serially. The adoption of GPGPU will significantly speed it up.

• GPGPU promises to deliver results with the same accuracy as when using the main FP-ALU but with less energy consumption..

• It will be possible to bring all these analysis to the machine close to patients.

•This project will evaluate the performance of the GPGPU approach in terms of practical use, compute time required and energy consumption.

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