



An interdimensional correlation framework for direct real-time estimation of six degree of freedom target motion using a single x-ray imager during radiotherapy

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Rationale

Problems

- ❑ Current cancer radiotherapy treatments assumes tumours are static and always aligned perfectly with the treatment beam.
- ❑ However, tumours do translates as well as rotates.
- ❑ Measurements of tumours translations and rotations during treatment will improve the probability of curing cancer.
- ❑ Only expensive specialised radiotherapy are capable of measuring tumours motions.

Solution

- ❑ This work presents the mathematical framework to measure tumour motions during radiotherapy using only a single rotating x-ray imager.
- ❑ X-ray imager is available in 90% of modern radiotherapy clinic
- ❑ This is a purely software solution; therefore, it is inexpensive and widely available.

Evaluation with liver tumour motions

VMAT Simulation: Benchmarking the accuracy of 6DIDC on patients liver tumour motion

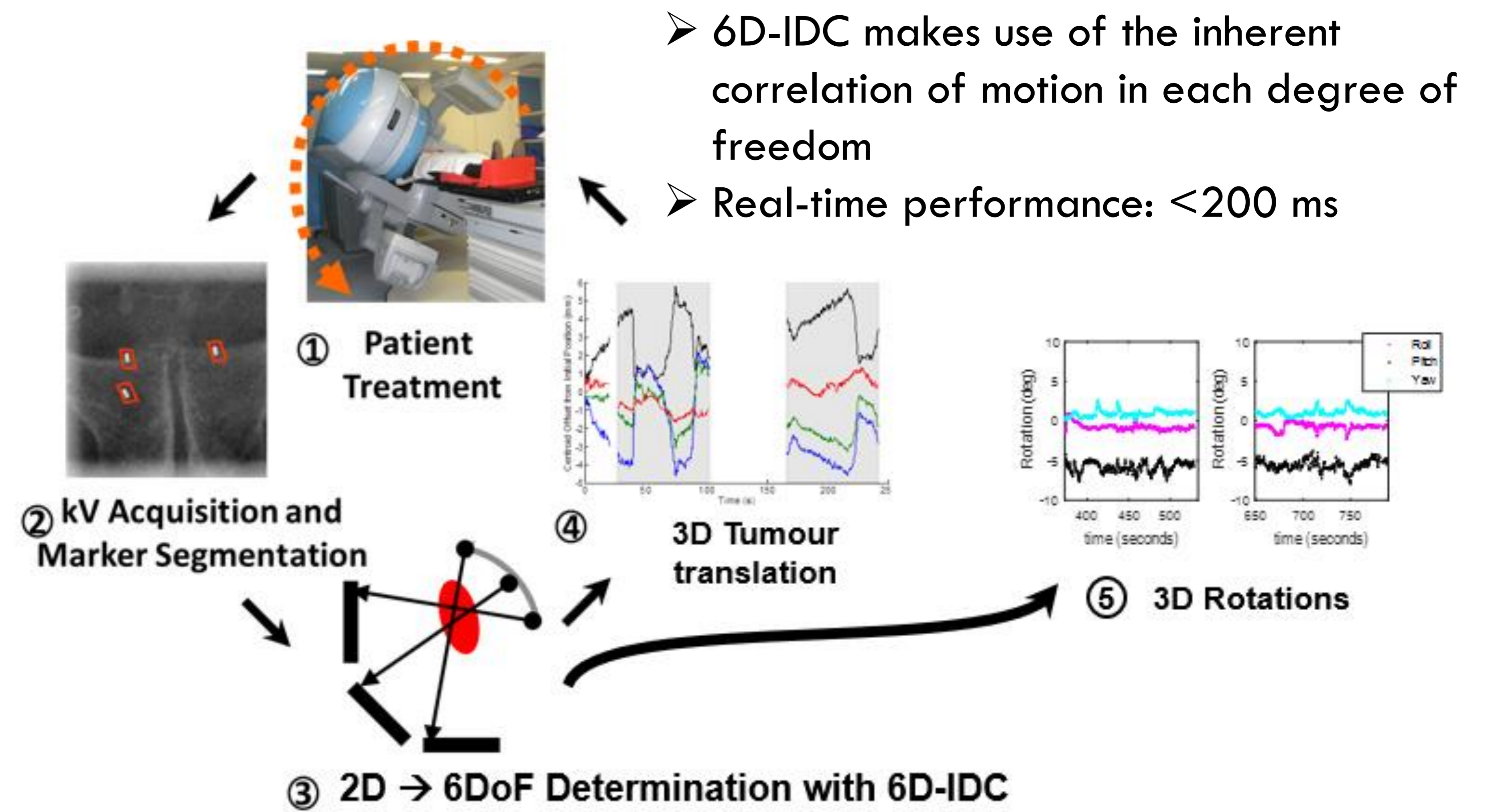
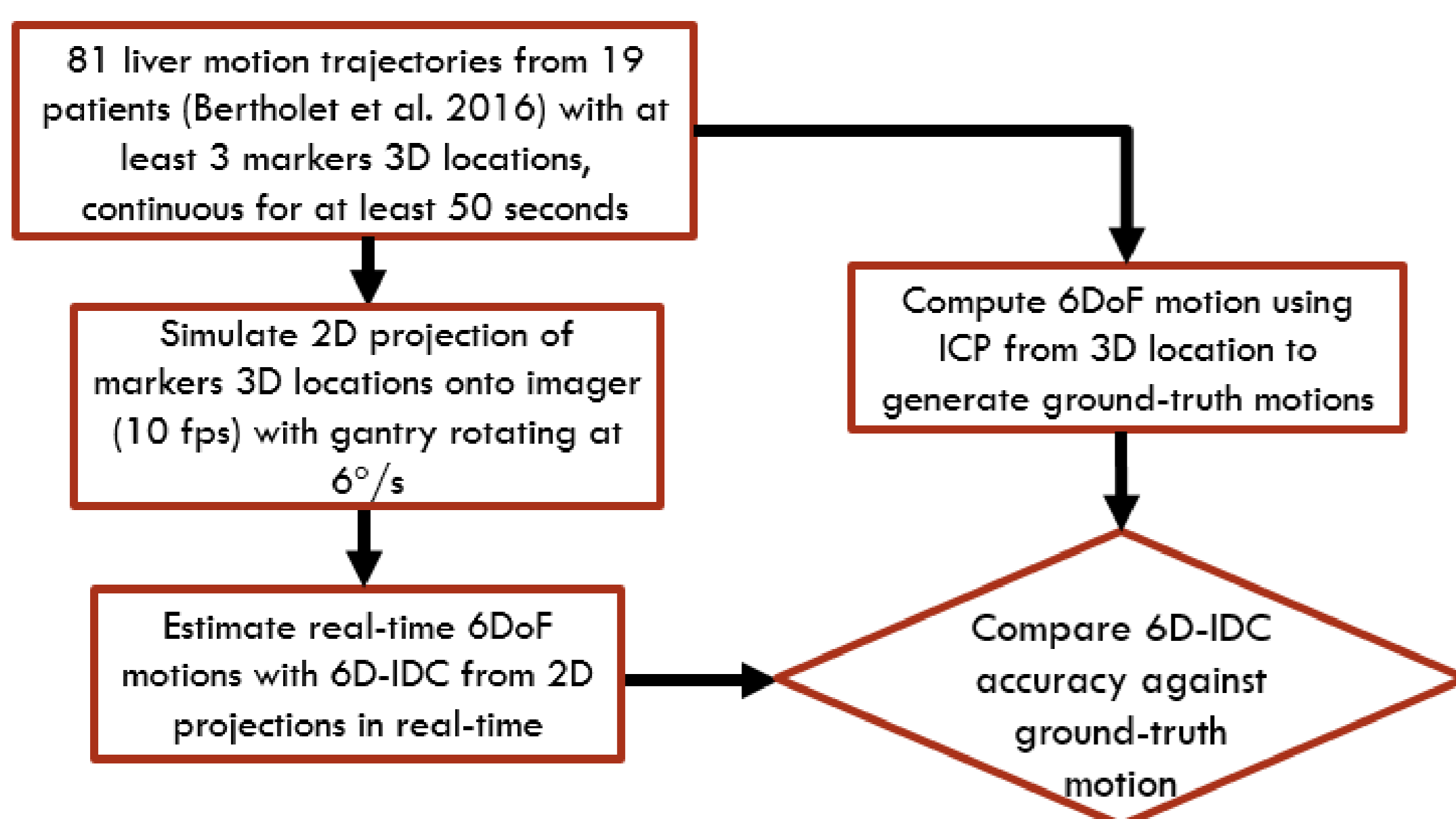
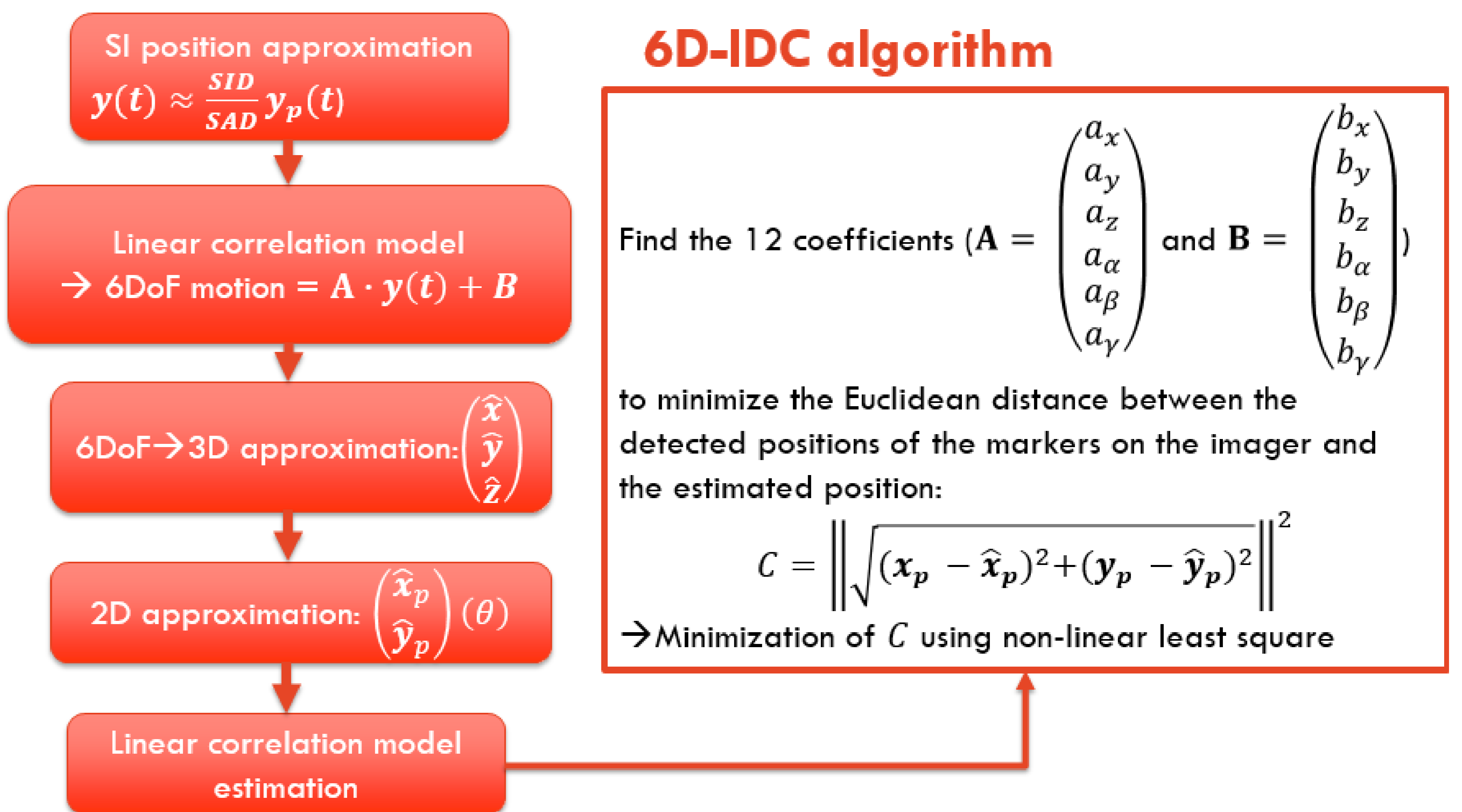


Fig.1. This work: a method to directly estimate 3D translations and 3D rotations (6 degrees of freedom) of tumour in real-time on standard radiotherapy equipment

Methods



Results

Table 1. Mean and standard deviation of the difference between 6DoF motions estimated by 6D-IDC and ground-truth motions.

	Mean error	Standard deviation of error	[5 th to 95 th] percentile interval
Left-Right (mm)	-0.03	0.32	[-0.55 – 0.50]
Superior-Inferior (mm)	-0.01	0.13	[-0.18 – 0.17]
Anterior-Posterior (mm)	0.03	0.52	[-0.64 – 0.73]
rLR (degrees)	0.07	1.18	[-1.51 – 1.70]
rSI (degrees)	0.07	1.00	[-1.50 – 1.70]
rAP (degrees)	0.06	1.32	[-1.53 – 1.68]

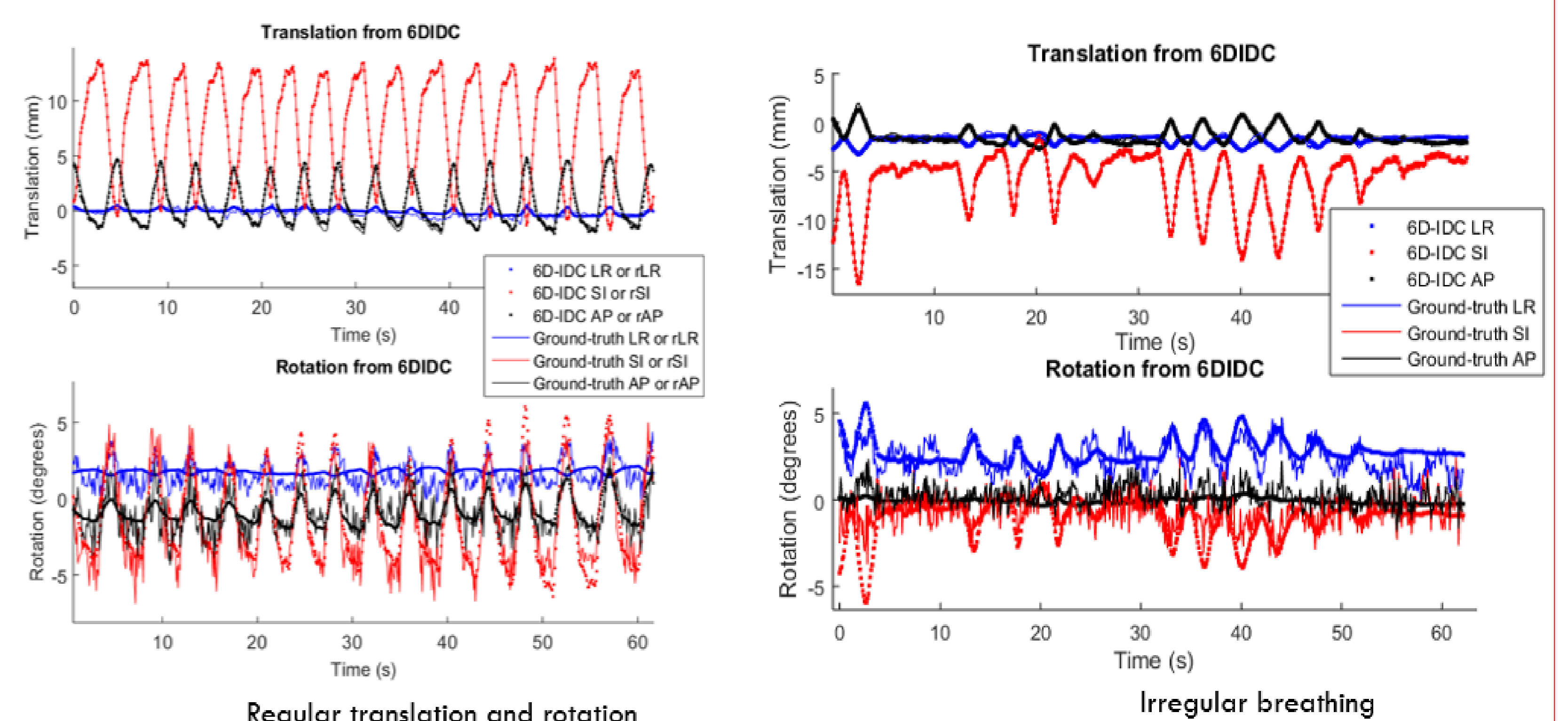


Fig.2. Examples of liver tumour 6DoF motions estimated by 6D-IDC algorithm, overlaid with the ground-truth tumour motions.