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EFFICIENT PLANNING OF LIVER TUMOUR SURGICAL INTERVENTION

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In this work we present the use of the PGD (Proper generalized decomposition) method to simulate and predict in real-time a surgical intervention.

The aim of this work is helping practician to better define the cutting plane to remove a liver tumour successfully, but at the same time to reduce to the maximum the unnecessary extraction of healthy tissue. The main difficulty of this problem is the real-time simulation. We have to be able to compute in real-time the deformation of the liver, so we can predict the real position of the tumour, based on patient position and external loads, also as the practician make an incision, the model must be updated to take into account the change of topology. A second difficulty is the time available to prepare the simulation. Geometry of liver, the position, size and type of tumour is patient dependent, so the preparation of the simulation must be done efficiently for every patient. The time available is about one week (time between the last Cat Scan of the patient before the actual surgery) and obviously this time cannot be extended.

The use of the PGD framework enable us to define a multidimensional parametric problem that takes into account tumour rigidity, progression of the cutting, external load and other parameters. The solution to this problem is pre-calculated and stored in a suitable format and then post-process in real-time.

The pre-calculated parametric solutions (also called computational vademecums) enable us to quickly evaluate a solution for a particular values of the parameters, so very suitable for real-time process. Also these computational vademecums can be certified for a given error tolerance to ensure the quality of the real-time response.