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Recalage multimodal et plate-forme d'imagerie médicale à accès distant

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sous la direction de
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Abstract

The work presented in this thesis takes place in a project named *Health and High-Performance Computing* (HPC), supported by *région Rhône-Alpes*, whose goal is to bring HPC in hospital environment. In this context, we have studied image registration techniques and developed a remote access medical imaging platform.

Multimodality image registration is an important problematic in the field of medical images analysis. The goal is to find a spatial transformation that relates two images, in order to combine both types of information held by each image. First, several similarity measures are presented and classified according to the assumptions made to estimate the link between the intensity distributions. A set of tests shows the differences between the measures, and we present an experiment which aim at using such measures for performing a content-based search in a set of images. Then, we study some interpolation procedures in term of accuracy, robustness and speed. We remark that, in a registration procedure, most of the time (up to 90%) is spent in the computation of the joint histograms. An original algorithm is then proposed, which allows to speedup the whole process, with a slight loss of accuracy in the final result. Such registration techniques are then applied in order to recover patient position in the field of conformal radiotherapy. Our new approach involves a content-based search in a set of pre-computing images, by the use of intensity-based similarity measures. The results are interesting as we are able, without any segmentation stage, to precisely estimate large patient displacements, involving out-of-plane rotations.

In the second part of the thesis, we present a platform called ARAMIS (*A Remote Access Medical Imaging System*) which aims at activating remote medical imaging parallel treatments. The proposed set of mechanisms allows practitioners to access through a simple Web browser, to powerful parallel systems. Remote 3D image treatments are activated on user's requests and the client's computer is only used to display the remotely computed 2D images. Finally, we describe an optimal algorithm for constructing the surface adjacency relation in a list of polygons, extracted from 3D medical images with the Marching-Cubes algorithm. A proof of the linear complexity of the method is given.

Keywords: multimodal registration, similarity measure, interpolation, pose determination, remote access platform, adjacency relation, conformal radiotherapy