

Digital Volume Correlation techniques for patient-specific simulation of vertebrae with metastasis

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ABSTRACT

Between 30 and 50% of breast and prostate cancer patients will develop spinal metastases [1] which could lead to the vertebrae's structural collapse and damage to the spinal cord. Our objective is to develop a software tool to assess the collapse risk to help in the selection of the most appropriate treatments for these patients. Thus, our objective is to develop a methodology to create a personalized numerical avatar of the patient's vertebrae that incorporates the physical (mechanical) behaviour of the bone to the CT image to obtain, through computer simulation, accurate predictions of the vertebrae's behaviour. The use of the Digital Volume Correlation (DVC) technique, which has already been used for biomechanical applications [2], is a key point in this project. Thus, in this contribution, we will present one of the first results obtained: the use of DVC techniques for the automatic detection of metastatic tumours in vertebrae after the primary tumour.

The basic idea of the procedure is to use DVC techniques to map the CT scans of a patient's vertebra onto a subsequent CT scan of the same vertebra obtained as part of the patient's follow-up procedure. The difference (residue) between the mapped image and the second CT scan represents the evolution between the two images. This residual has already been successfully used to automatically highlight areas where the second CT scan showed the appearance of a tumour. We believe that this technique has great potential to be used in the development of a diagnostic aid tool for the early identification of tumours in vertebrae. A key aspect in the development of this type of tool, so that it can be used in the demanding clinical environments and to carry out precise simulations of the structural behaviour of vertebrae with tumours, is the automatic segmentation of the vertebrae, which will be the object of our future developments.

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