3D Facial keypoint detection using deep learning

**Context:** Detecting facial keypoints is a challenging problem. Facial features vary greatly between individuals, while large intra-subject variations are caused by changes in pose, viewing angle, illumination conditions and facial expressions (see fig. 1). These keypoints, however, prove to be helpful in a large number of problems, including those of image registration, face tracking & analysis and face recognition.

![Figure 1: Example results of a deep convolutional network detecting facial keypoints](image)

A relatively new and emerging approach in the field of machine learning is deep learning. Deep learning relies on a class of machine learning algorithms that use cascaded layers of nonlinear processing units, in order to transform multidimensional data into abstract features. Each layer takes input from the previous layer, and produces output for the next layer, allowing for higher-level features at each layer. Doing so, deep learning nets have proven to be successful at facial keypoint detection on 2D images (see fig. 1). Detecting these keypoints on 3D images, however, has not been addressed as frequently.

**Thesis goals:** The student will work on the problem of 3D facial keypoint detection employing deep learning practices. The goal is to achieve a practical implementation of a deep net, capable of detecting facial keypoints under varying conditions. Sufficient data (3D facial meshes and texture scans) is available and will be provided to the student during his/her work.

**Guidance:**
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**Profile:**
The thesis contains strong theoretical as well as practical aspects. Machine Learning & Artificial Neural Network courses are a must. Programming experience is a plus. The thesis will be performed at the Medical Imaging Research Center (MIRC) at UZ Leuven (Gasthuisberg).

**Number of students:** 1