Using line features for 3D face registration

Fabian Brix

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Abstract

In this bachelor thesis we attempt to modify the existing face registration pipeline for the morphable face model of Prof. Thomas Vetter by using a registration algorithm developed by PD Marcel Lthi at the University of Basel. ALTERNATIVE: In this bachelor thesis we discuss the construction of a face registration pipeline. The using an algorithm based on a vector-valued gaussian process and at the same time attempting to ensure registration quality through the use of contours marking important parts of the face - referred to as line features.

The algorithm is capable of mapping any two shapes on to one another. All that is needed is a set of corresponding points on the two shapes. Different constraints to the displacement field can be applied through regularisation.

The aim of this bachelor thesis is more specifically to apply this general algorithm for point correspondences to scanned face data, that is to implement feasible registration of face scans onto the mean face of the morphable model. In order to achieve this we mark important parts of the face meshs not only with point landmarks, but also structures and organs (eyebrows, eyes, ears) with lines - line features - and thereby to create further correspondences for the algorithm to perform better by. Instead of using sparse points of key features points of the face we mark complex features, e.g. the eyes, with contour lines - line features in order to create further correspondences

These line features are marked by hand using bzier curves on three 2D images to the front, left and right of the 3D face. In order to utilize them, however, they have to be projected on to the computed mesh of the face that was recorded by a 3D scanner. These meshs have holes in the region of the eyes and the ears rendering the projected line features useless at first. This thesis first gives an overview over the morphable model and the face registration pipeline, then goes on to obtaining 3D points from the 2D line features, to explain the theory behind the general algorithm and in the main part discusses the problems and solutions we encountered trying to optimize the algorithm for and without line features for the face registration process.

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Chapter 1

Introduction

1.1 Problem Statement

So es bizzeli alles schriebe 1. Use Gaussian Processes - 2. Use Line Features =¿ prepare for Gaussian Process Regression In this bachelor thesis Implement 3D face registration using Gaussian Processes and Line Features. One part of the problem is to sample equidistant 3D points from 2D line features marked on images of a 3D face scan. These line features should then be used as an additional input to a registration algorithm which is based on Gaussian Process Regression. The aim is to build a pipeline which starts off with the raw scan data as well as the landmarks and line features. The feature points are used to register the mean face of the MM/BFM (Basel Face Model) on to/with the raw scan thereby obtaining a fully defined and textured 3D model representation of the face in 3D. Registration is the technique of aligning to objects using a transformation, in this case the registration is performed by adding displacements to every points in the mean face model. A model is represented as vector N*d. What is a model? A vector representation of a 3D scan? For the morphing a Posterior Shape Model is used in combination with a Gaussian Process. Image registration is a process of aligning two images into a common coordinate system thus aligning.

(gaussian process + line features for accurate, reproducable registration)

1.2 Review Literature

2. Definition of terms (morphable model, 3D face registration, Gaussian Process regression, posterior shape models) 3. Review of literature (papers)