Initial Plan

Creating a dataset of 3D deformed shapes for evaluating 3D model registration techniques

One Semester Individual Project (40 Credits)
CM3203

Author: Caleb Stride
Supervisor: Prof. Paul Rosin

Contents:

1.   Description

The use of 3D data has been steadily increasing in the past years as more and more affordable applications have been created that use 3D data.

To create 3D data from real life objects they need to be scanned by some sort of 3D scanner. Due to occlusion of the object the scanner needs to scan from multiple angles to create a model of the whole object. These scans need to be aligned using registration techniques to create an accurate representation of the 3D object.

At this moment in time many registration algorithms exist to align multiple scans. But few techniques exist for evaluating the effectiveness of these registration algorithms.

The main aim of the project is to create a dataset of 3D deformed shapes which contain known correspondences. The dataset can be used to evaluate algorithms that perform registration techniques between different scans of the same object. The corresponding points will be found by placing markers on the object and analysing the texture information so the markings can be matched between scans.

I previously undertook a CUROP with the same aim as this project. However, there were areas that needed improving and modification. So, to start of this project I will first evaluate and look at how the older system can be changed to produce a better set of data.

2.   Aims and Objectives

2.1.   Main Aims and Objectives

Below is a list of the main aims and objectives of this project. These would be required if I wished to fulfill the overall aim of the project.

- **Acquiring and Scanning Objects**
  An appropriate range of objects would be selected with the aim of having a range of different transformations. The selected objects would need scanning in different positions so appropriate correspondences can be created.
- **Finding Markings on 3D mesh data**
  The texture maps of the objects can be analysed. From this the positions of the markings can be located.
- **Finding the corresponding points on different scans**
  For each pair of object scans, the located markings on one scan need to be matched with their corresponding markings on the other scan.
- **Evaluate different registration techniques**

By running different registration techniques possible corresponding points will be found from my data. I can evaluate these techniques by looking at how close their possible correspondences come to the true correspondences in the data.

2.2.   Extra Aims and Objectives

The following points could possibly be implemented if there is adequate time after implementing the main points. These are not necessary for the programme to run but would likely increase its overall effectiveness and usability.

- **Different colour markings and background colours**
  Allow for the markings on the object to be dynamically found and defined instead of using a set of predefined markings. This may include using different colour and patterns for markings.
- **Increasing accuracy and data size**
  Increase the amount of markings that are correctly detected, and their corresponding points found. Explore more scenarios where objects may be deformed between 3D scans e.g. faces.
- **Create registration technique**
  If loads of spare time, then I can try to create my own simple registration technique. I can then test it on the data created and see how well the calculated correspondences match with the ones found via texture information.

3.   Ethics

My project requires no ethical approval as it will not involve people's personal data or require any experiments on people.

4.   Work Plan

The initial plan is due at the start of week two. Then the final deadline is on 10/5/19 which requires the whole project to be completed and submitted. It would be a good idea to make sure everything is completed to a suitable standard a few weeks before this date. This would allow me to improve on my project whilst still knowing it was ready to submit. I also must note the dates of the Easter break as it may impact the availability of my supervisor. Towards the end of my project I may need to prepare for exams, so I made sure that there was less work to be doing. Below is a rough outline of my project plan. This is subject to change, but any major changes will be commented on and explained in my final report.

Week 1 (28/1/19)
- Writing my initial plan
- Organising meetings and deadlines

Week 2 (4/2/19)
- **Milestone** - Initial Report completed and submitted
- Research of current methods for testing registration techniques and current datasets which contain correspondences between scans
- Critical analysis of current programme for finding corresponding points between scans based on texture information

Week 3 (11/2/19)
- From my critical analysis decide how the algorithm can be improved to increase the accuracy and reliability
- Start planning the new algorithm and what kind of texture information and markings it will be able to handle

Week 4 (18/2/19)
- Review Meeting
- Start collecting objects making sure they contain a range of different transformations and appropriately mark them
- Scan these objects in multiple poses to allow correspondences to be found

Week 5 (25/2/19)
- Find a way to find the markings by looking at the texture map of the object
- Make sure these markings are correct by some sort of checking
- The markings may need to be defined in some way so finding corresponding markings between scans can be done

Week 6 (4/3/19)
- Corresponding markings on each scan of an object need to be found
- Prune the correspondences so only likely ones remain

Week 7 (11/3/19)
- **Milestone** - Working version of programme
- Review meeting
- Review the current algorithms and see how effective it is as finding the markings and matching the corresponding ones together

Week 8 (18/3/19)
- Improve the accuracy of correspondences and increase the amount of correspondences found

Week 9 (25/3/19)
- **Milestone** - Improved working version
- If more time available, then I can work towards some of the extra aims and objectives

Week 10 (1/4/19)
- Analyse my algorithms by looking at the percentage of markings that have been correctly identified and have had their correct corresponding point found
- Test current registration techniques on my data, then use the corresponding points I found to analyse these techniques
- Review Meeting

Week 11 (8/4/19)
- Start gathering all the information gained in previous weeks and structure it into a report
- Analyse and reflect on the project detailing current issues and ways the project could be improved

Week 12 (15/4/19) Easter
- **Milestone** - Complete the report

Week 13 (22/4/19) Easter
- Look through the report and add any missed details
- Do some more testing of registration techniques to see the benefits of my dataset

Week 14 (29/4/19) Easter
- Look for any points that can be improved or expanded on

Week 15 (6/5/19)
- **Milestone** - Submit project code and the report
- Final touches to report and deliverables to make sure they can be submitted
- Final Review meeting