C2D2 Centre for Chronic Diseases & Disorders

Development of 3D Morphable Face Model for Planning, Guidance and Assessment of Craniofacial Surgery

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Problem domain. We aim to develop a statistical model of human face shape that is able to predict how a face should look after any surgical procedure. It is intended to be used as an aid to surgical planning, guidance and outcome assessment, in particular for children with Apert syndrome and other syndromes that significantly affect craniofacial structure and appearance.

First steps. C2D2 funding has allowed us to collaborate with GOSH in a 3-month priming project. Here, we demonstrated sparse 3D face model fitting to the GOSH face dataset. Sparse model fitting is an essential precursor to dense model fitting and requires manual mark up of a set of salient facial points for model training. We also built a new tool that allows efficient manual mark up of data. See figure below for sparse model fitting process. Further examples of sparse models fitted to various 3D scans are shown bottom left.

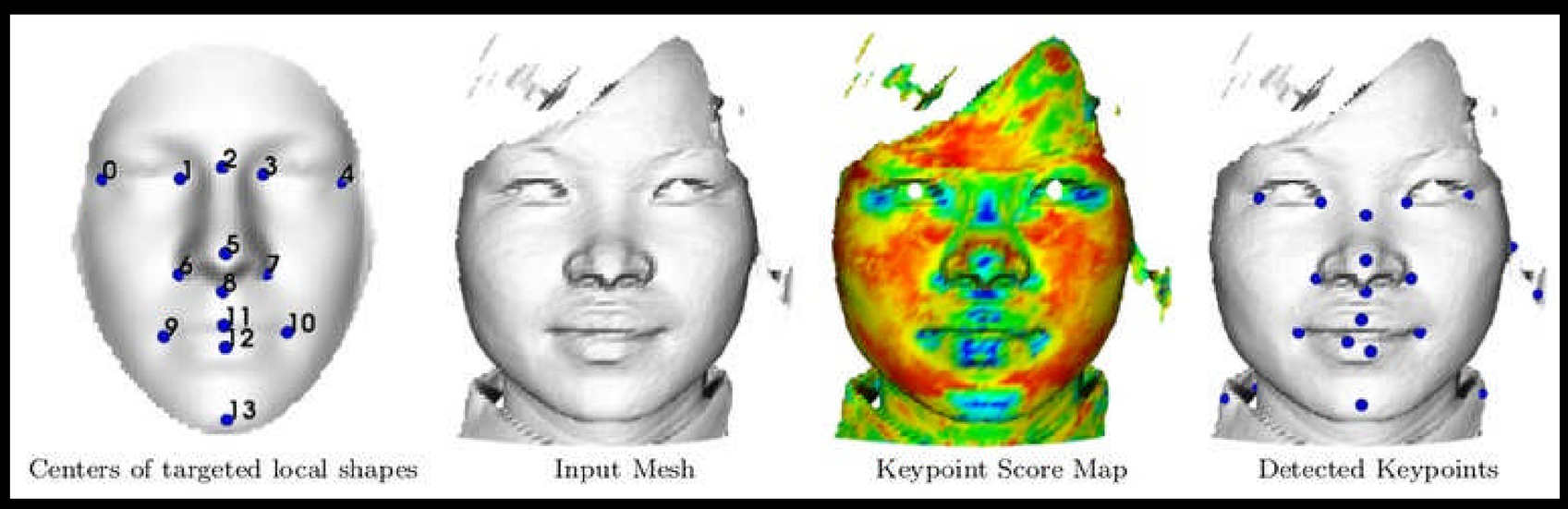

Fig 1. Automatic sparse model fitting

Collaboration. We are collaborating with craniofacial surgeons David Dunaway and Allan Ponniah from Great Ormond Street Hospital (GOSH). As well as being end users of any new technology who can inform its development, GOSH have around 12000 3D facial scans of the human face from a diverse range of ethnicity, age and gender. These will be used to train our 3D face model.

Full solution. There are two high-level problems to solve in our future work:

1) How to put a large body of 3D face scan data into *dense* correspondence. That is, every point on every face scan has a unique label, and all points with the same label correspond to the same point on the face. This may or may not be a salient point, such as nose tip or eye corner.
2) Given a dense correspondence across many faces, how do we model face variation?

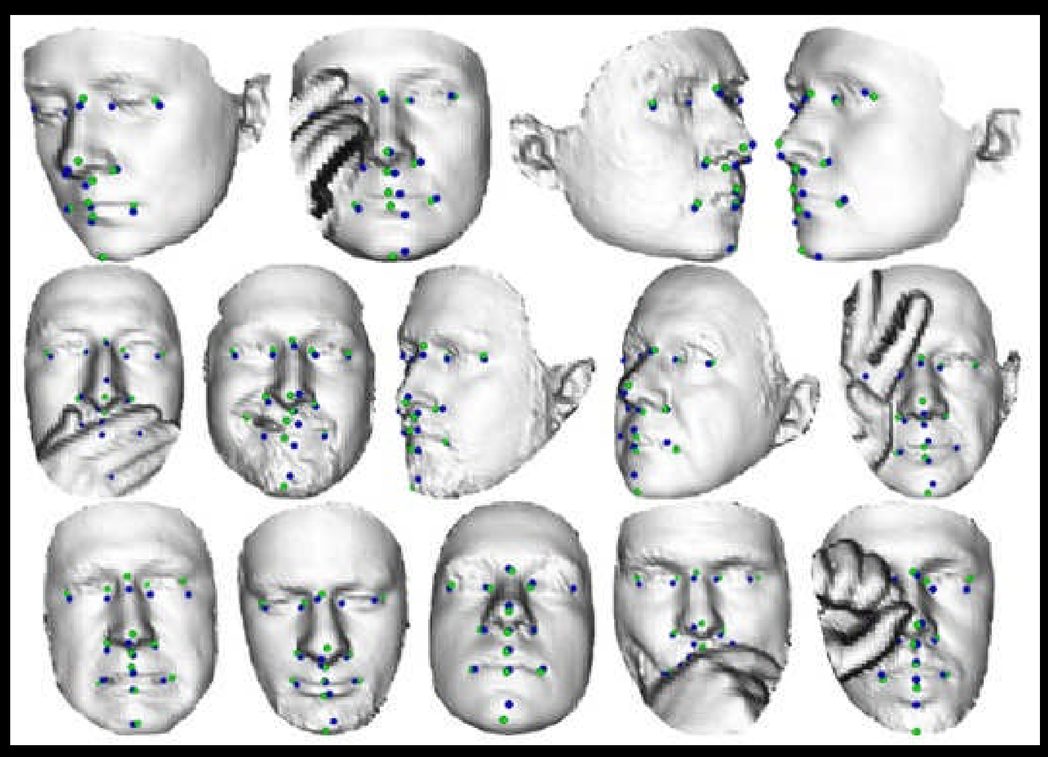

Fig 2. Green points manually marked, blue points automatically determined from sparse model fitting

Follow on funding. This C2D2 priming project directly led to the PI being awarded a Royal Academy of Engineering / Leverhulme Trust Fellowship for the 2013-14 academic year. The three investigators are also seeking further support from various funding bodies. We aim to package our work into a user friendly toolbox that can be used by clinicians and other user groups, such as academics.

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