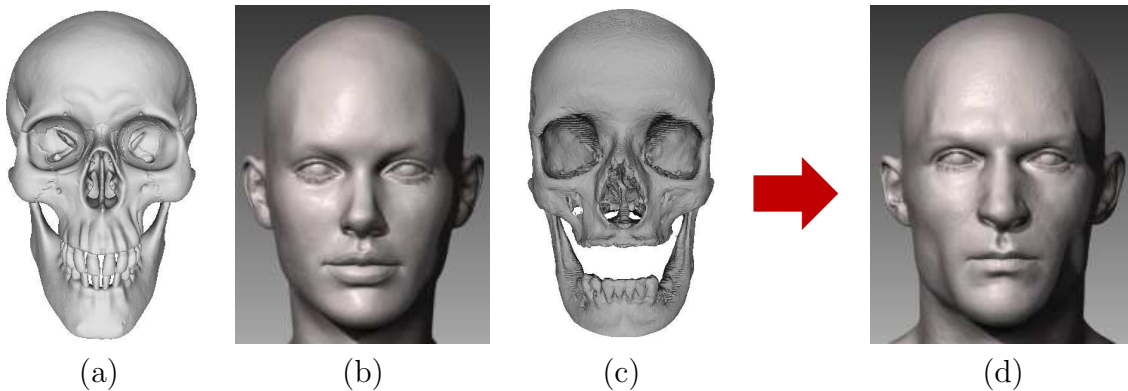

CS5240 Theoretical Foundations in Multimedia
AY2023/24 Semester 1
Example Project Topics

The following is a list of interesting project topics. Some of them are actually proposed by previous students. You are encouraged to propose your own project topic, as long as it is within the scope of CS5240. Topics on transformation and registration, whether spatial, temporal or both, are appropriate. If you are unsure whether your idea is within the scope, please consult the lecturer.

1. Construction of Face From Skull



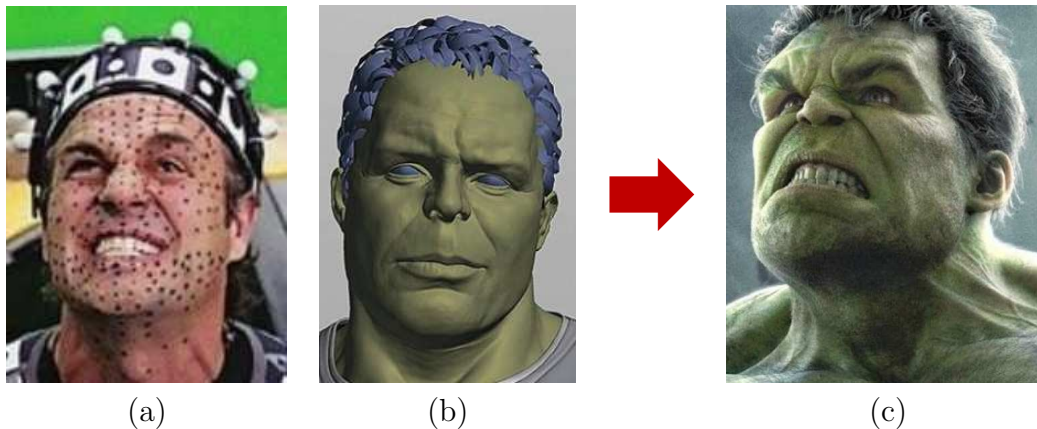
Given (a) a reference 3D skull model, (b) a reference 3D face model and (c) a target 3D skull model, construct (d) the target 3D face model that best matches the target skull model. The known 3D models come with a small number of known landmark points. Omit the ears, nose and lips which cannot be constructed from the skull alone.

This technology is useful for forensic investigation and craniofacial surgery.

Difficulty Levels:

- Entry level: Correspondence between the landmarks is known. Age, gender and body mass index of the reference and the target are the same.
- Intermediate level: Correspondence between the landmarks is known. Age, gender and body mass index of the reference and the target are different.
- Advanced level: Correspondence between landmarks is unknown. Age, gender and body mass index of the reference and the target are different.

2. Generation of Facial Expressions



Given (a) a temporal sequence of the positions of 3D landmark points on a reference face and (b) a target 3D face model of a different person with neutral expression, generate (c) a temporal sequence of target 3D face models that fit the reference expressions. The target 3D face model at neutral pose comes with known landmark points. Omit the colour and texture of the face model. Just focus on the shape of the face model that exhibits facial expression.

This technology is useful for movie special effects, e.g., making the Hulk screams like his actor Mark Ruffalo.

Difficulty Levels:

- Entry level: Correspondence between reference landmarks over time is known. Correspondence between reference and target landmarks is known.
- Intermediate level: Correspondence between reference landmarks over time is known. Correspondence between reference and target landmarks is unknown.
- Advanced level: Correspondence between landmarks is unknown.

2a. Generation of Facial Expressions



This project topic is similar to Project 2, except that the temporal sequence of reference landmarks are 2D landmarks that lie on 2D images. The target face at neutral pose remains

as a 3D face model of a different person with known landmark points. The objective is to generate a temporal sequence of target 3D face models that fit the reference expressions.

2b. Generation of Facial Image Expressions

This project topic is similar to Project 2, except that the temporal sequence of reference landmarks are 2D landmarks, and the target face at neutral pose is a 2D image of a different person with known landmark points. The objective is to generate a temporal sequence of target 2D face images that fit the reference expressions. Thus, the pixel colours of target images cannot be omitted.

3. Placement of 3D Furniture in 2D Room Image

This project topic was proposed by previous students.



(a)



(b)

Given (a) the 2D image of a room and (b) the 3D model of a furniture, place the 3D furniture model in the 2D room image so that 2D projection of the furniture model fits the room layout. The 2D image and 3D furniture model come with a small number of landmark points. Omit the colour and texture of the furniture model. Just focus on the placement of the furniture model.

This technology is useful for furniture shops such as IKEA.

Difficulty Levels:

- Entry level: Correspondence between landmarks and camera parameters are known.
- Intermediate level: Correspondence between landmarks is known. Camera parameters are unknown.
- Advanced level: Correspondence between landmarks and camera parameters are unknown.

3a. Placement of 3D Building in 2D Scene Image

This project topic is similar to Project 3.

4. Virtual Garment Fitting

This project topic was proposed by previous students.



Given (a) the 2D image of a person and (b) the 3D model of a garment, produce (c) an image with the garment fitted to the person's body. The person's image and the 3D model have known landmark points. Moreover, the camera parameters are known. Omit the colour and texture of the garment. Just focus on the shape of the garment.

This technology is useful for garment shops.

Difficult Levels:

- Entry level: Correspondence between the landmarks is known. Loose fitting of garment to human body.
- Intermediate level: Correspondence between the landmarks is known. Tight fitting of garment to human body.
- Advanced level: Correspondence between the landmarks is unknown.

4a. Virtual Eyeglasses Fitting

This project topic is similar to Project 4, except that a pair of eyeglasses is a rigid object.

4b. Virtual Necklace Fitting

This project topic is similar to Project 4, except that a necklace is non-rigid but less flexible than garment.

5. Generation of 3D Bas-Relief Model

This project topic was proposed by previous students.



Bas-relief is a kind of sculpture with the sculpted elements attached to the solid background. It has less depth than what the sculpted elements depict. For this project, the objective is to generate the 3D model of a bas-relief given the 3D points of the bas-relief recovered by 3D scanning technology. The 3D points scanned by laser technology are typically quite accurate, with very little noise. But, there are outliers that belong to the table-top on which the bas-relief is placed for scanning.

3D points



3D model



Difficult Levels:

- Entry level: The outliers have been removed. Generate a coarse 3D model.
- Intermediate level: There are outliers that belong to the table-top. Generate a coarse 3D model without the table-top.
- Advanced level: There are outliers that belong to the table-top. Generate a detailed 3D model without the table-top.