3-D Facial Imaging for Identification

Anselmo Lastra
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The Team

- UNC
  - Henry Fuchs
  - Pete Stein
  - John Thomas
  - Herman Towles
  - Greg Welch

- SIS
  - Will Austin
  - Alex Chen
  - Les Elkins
  - Ali Farsaie
  - Ping Zhuang
The Vision

- For program like Global Entry, NEXUS, or SENTRI
  - Capture 3D as trusted travelers are walking down hall
  - Perhaps driver of car entering USA?
- Use 3D face shape for identification
  - Ex.: comparison with a card or passport with RFID
  - *3D face shape found as effective as high-resolution photography or iris recognition in 2006 Face Recognition Vendor Test Report*
The Project

• Goals are to capture a 3D model of the face
  – Accurately,
  – Rapidly, and
  – Unobtrusively

• How do you do this?
Basics of Stereo Vision

- Use 2 (or more) cameras
The Two Camera Views

• Notice that they’re different, like from your 2 eyes

Left Camera

Right Camera
Making the 3D Model

- If we can identify the same point in two views, we can compute depth at that point, and thus a 3D model.
Big Problem: Correspondence

- What if we can’t find corresponding point?
  - Like our poor friend’s nose?
  - Or a human’s cheeks or forehead?
- This is a general problem
  - Imagine making 3D model of object with a solid color
Structured Light

• The idea is to project texture on the object (in this case, the face)

• Flashing textures, however
  – are disturbing, and
  – not good idea while walking

• Which leads us to one task of this project

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Imperceptible Structured Light

• Use light imperceptible to human, while visible to camera

• Two approaches
  1. Imperceptible Structured Light – rapidly flash pattern and then inverse of pattern (human can’t perceive if above flicker frequency – looks like white light)
  2. Infrared light source and infrared sensitive cameras
Speed

• Computation another big problem
  – Acquire images in fraction of second
  – Don’t want to wait 10 seconds to process
• Second major task: speed this up
• Our solution: use graphics processor (GPU)
  – Can be up to 40 times faster than CPU
  – Highly parallel
Remaining Project Work

• Today we’re presenting preliminary results
  – Still need more work to complete both parts

• Next
  – Infrared
    • Have ordered parts to build
    • Will compare to visible light
  – Low Light (optional)
    • Would like to not have to blast the people with light (whether visible or IR)
    • Also for good results on darker skin
    • Will investigate techniques for low contrast
More Challenges

• To achieve our full vision, need to
  – Cover large spaces
    • Multiple projectors
    • Overlapping cameras
  – Handle moving people
    • Fill in detail over time