Vision & Graphics

Frédo Durand
MIT CSAIL
Interaction is already strong

• Rick Szeliski received the Siggraph Achievement Award 2011

• Anat Levin received the Eurographics Young Researcher Award 2010

• Vision is used in special effects

• Computational photography
Bibliometrics: top vision papers

- Snakes
- SIFT
- Edge detection
- Multiview geometry
- Iterated Closest Point
- Optical flow
- Anisotropic diffusion
- Ransac
- Stereo
- Harris corners
- ... are used in graphics
Computer vision

• Add value to visual inputs

• Be open minded about
  - input
    - active, passive, 2D, 3D, 4D, etc.
  - added value
    - depth, recognition, flow, etc.
  - way to add
    - math, hack, stat, engineering, etc.
Acquisition

• Geometry
  - Also non-Lambertian materials
  - Also messy materials (hair, etc.)

• Complex deforming geometry
Acquisition: Geometry++

- A depth map is often not the final answer
  - not even always necessary
- Segments, parametric patches
- Full volumetric model
- Procedural models
  - buildings, trees
- Finding symmetries
Acquisition

- **Material Appearance**
  - clouds, smoke, fire

- **Volumetric media**
  - active or markerless mocap

- **Articulated characters**
  - active or markerless mocap

- **Complex deforming geometry**
  - physical parameters for simulation
Active techniques

• They’re great, don’t overlook them
• Still require a lot of computation
Content creation

• Biggest challenge in graphics
• Can vision help?
• related to capture, 3D acquisition, etc.
• Sketch-based modeling
• Priors for modeling/editing
Analysis-resynthesis for editing

• Recipe:
  - Analyze input/ decompose
  - Edit layers/channels/components
  recombine / rerender

• Images
  - HDR
  - relighting

• 3D data

• Motion

• => low to mid-level analysis is important
Priors for synthesis

• Can we use natural priors to synthesize motion, images?

• Texture synthesis
  - inpainting
  - making CG more real

• Motion
  - Used a lot for humans
    (see Aaron)
  - Cloth, hair, fluids?
  - Directly from video?

• Priors used directly in 3D renderer?
Applying vision to other signals

- Geometry
  - challenge: domain is conflated with range
- Motion capture data
- PDEs, signal processing, edge detection
- Features, retrieval, recognition
- Priors

Fig. 2. Flow of the ShapeGoogle algorithm.
Using graphics for Vision

• Ground truth, training data

• The image formation equations are the same
  - Example: motion blur, depth of field
  - Graphics knows more about light transport, material appearance

• Human motion modeling
Where graphics culture is better

- Connection to the real world
- Speed, scalability
- Systems issues, languages, API
- Most important publications easy to identify
  - Fewer siggraph papers than ICCV+CVPR+ECCV
- ... Siggraph parties are better but vision conference locations are better
Recap: connections

- Acquisition
  - Geometry, material appearance, motion
- Active techniques
- Content creation
- Analysis-resynthesis for editing
- Priors for synthesis
  - images, motion
- Applying vision to other signals
  - motion, geometry
- Using graphics for vision