

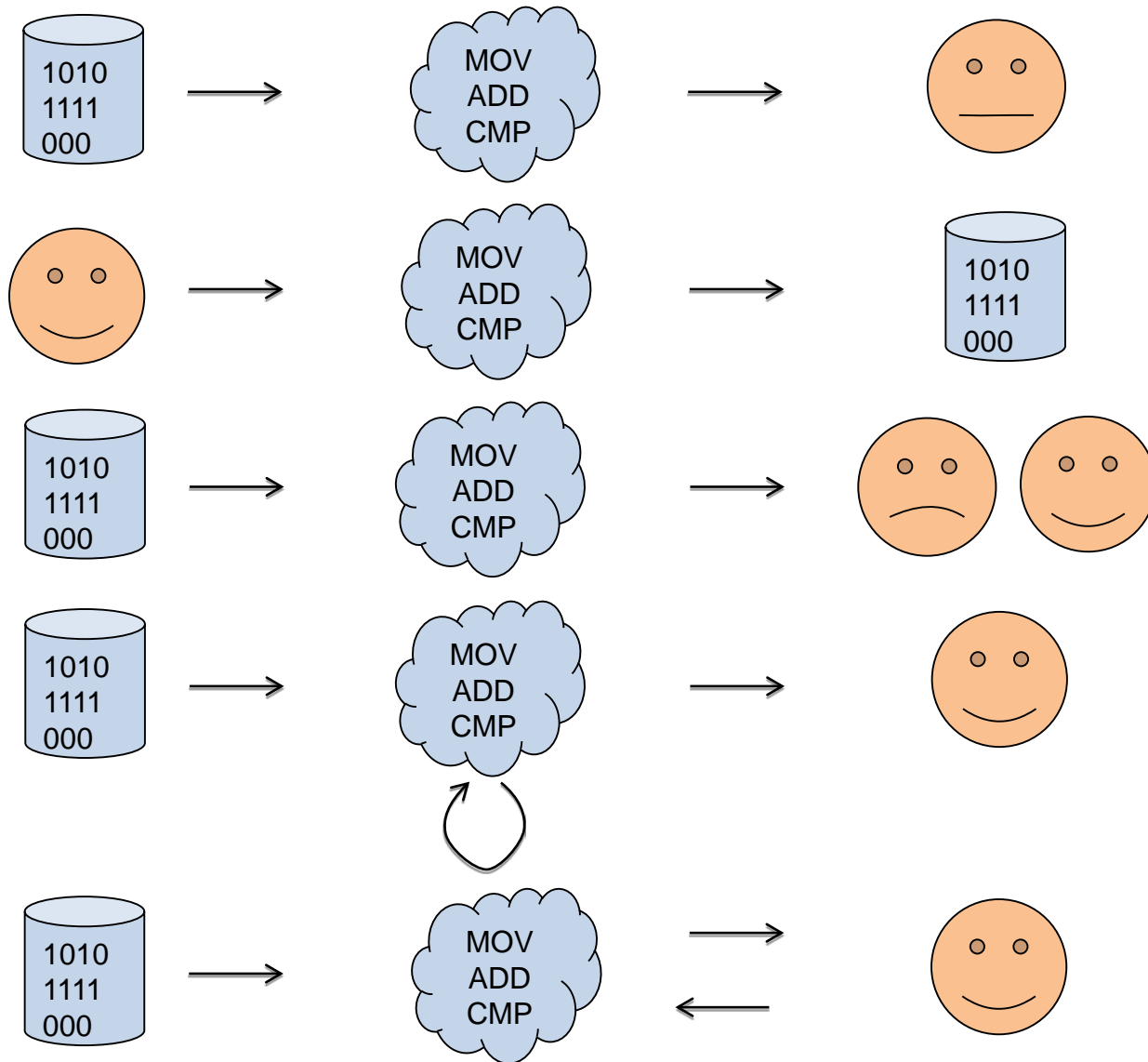
Declarative Visualization

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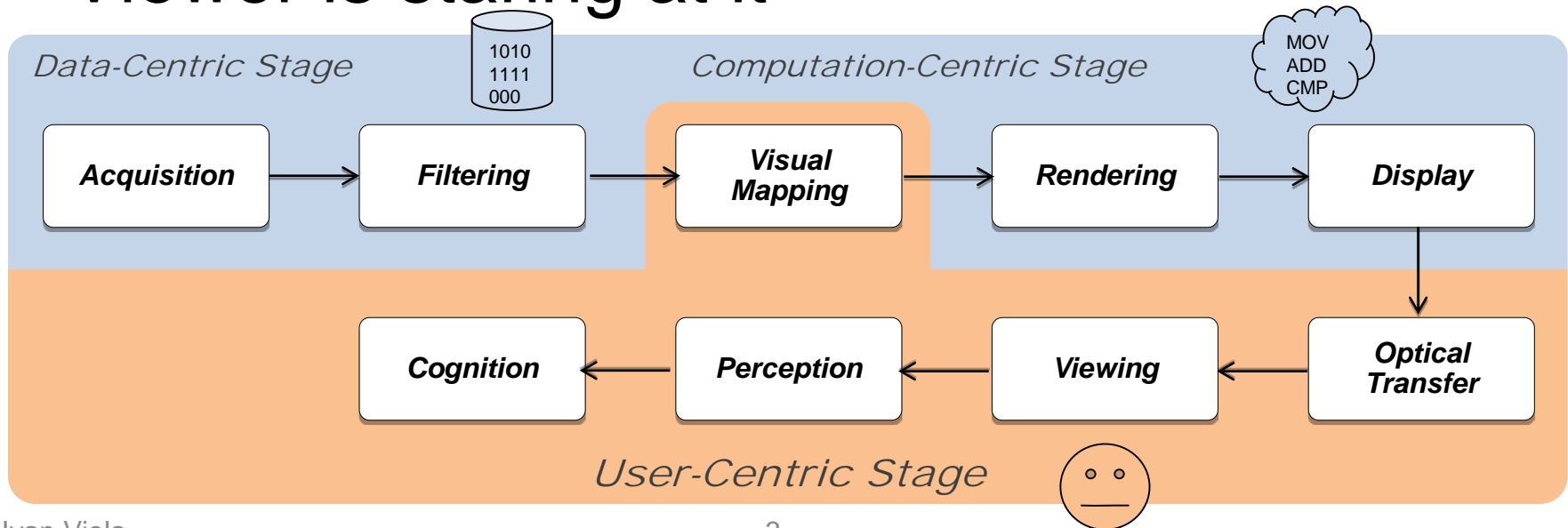


Pipeline Patterns



Traditional Visualization Pipeline

- Aligned with the data-flow network
- Data is “thrown over fence” on visualizers
- Piped into visual representation
- Splatted on to the display
- Viewer is staring at it

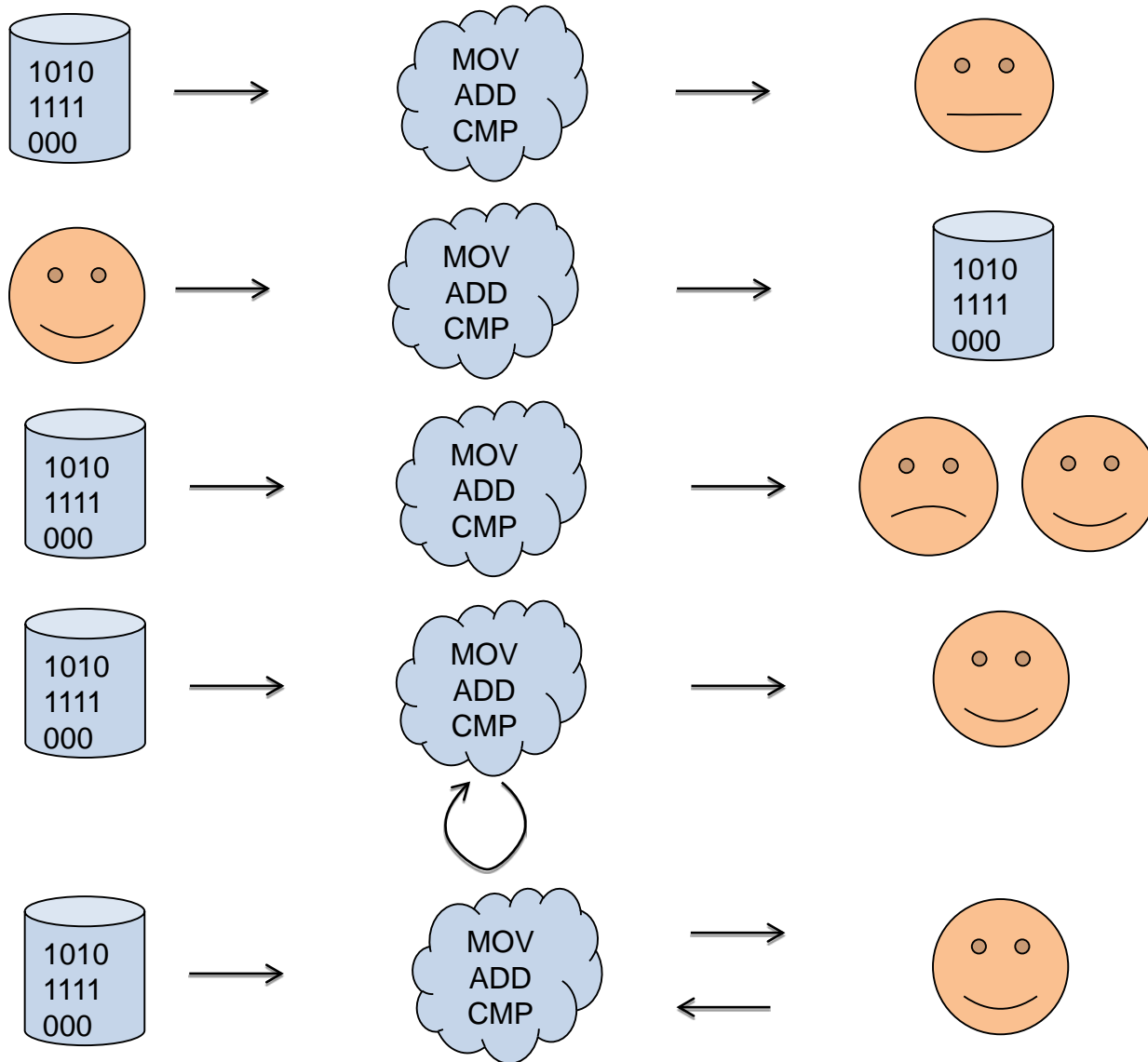


Direct Volume Rendering



- Imperative character
- Multitude of parameters to adjust (which could be automatized)
- Effect of parameter change is hard to predict

Pipeline Patterns



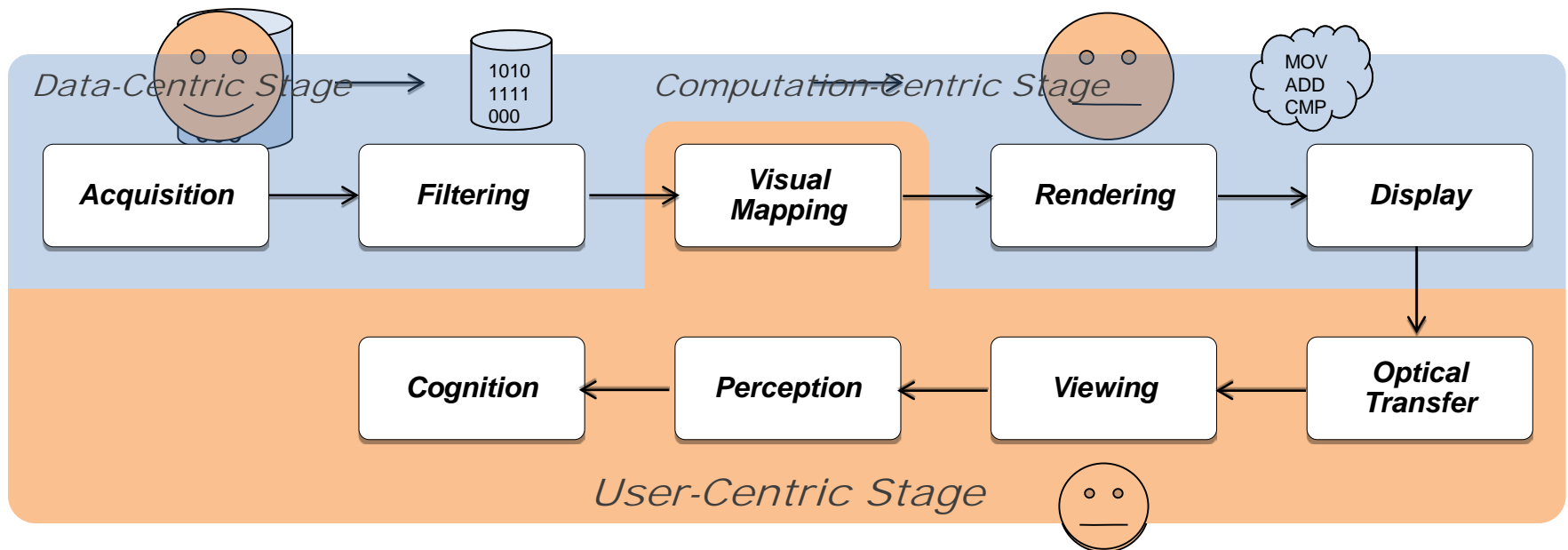
Visualization Goal

- Visualization is enabling technology
- Primary goal is to provide insight
- Exploiting perceptual / cognitive capabilities
- Specific tasks to reach the goal
- Strictly generic pipeline does not exist
- Common pattern: visual dialog: $H \Leftrightarrow M \Leftrightarrow D$
- Data: measurements, models, mental reps.
- Goal is the reason for visualization

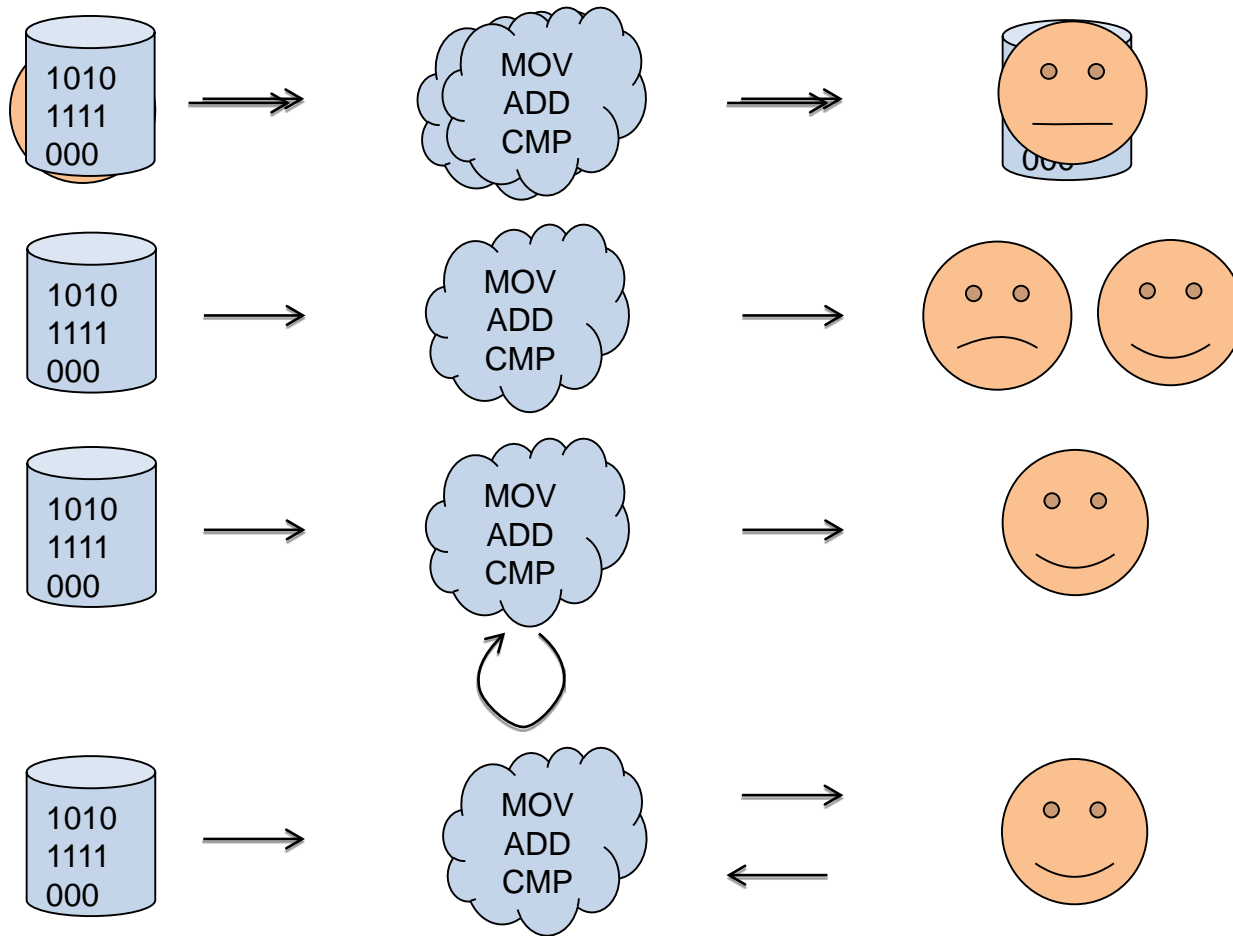


Information Flow

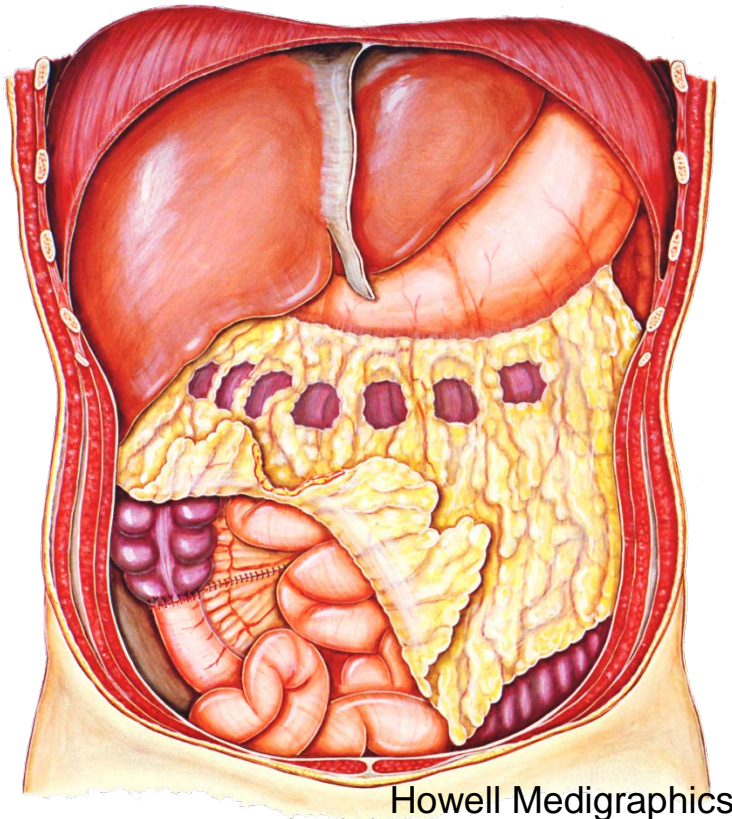
- Imperative paradigm: Splat data on the user
- Declarative paradigm:
User drives visualization of data



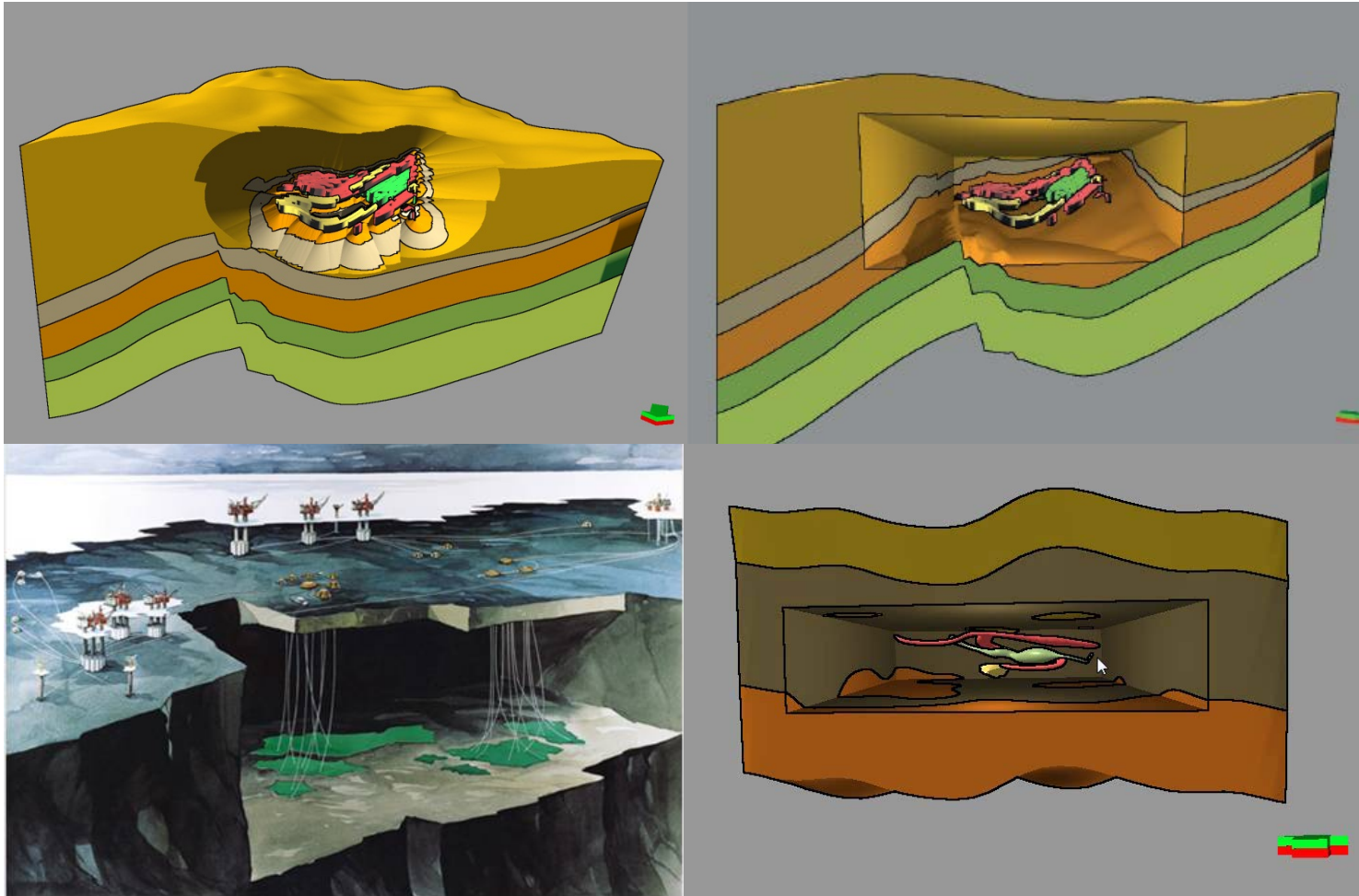
Pipeline Patterns



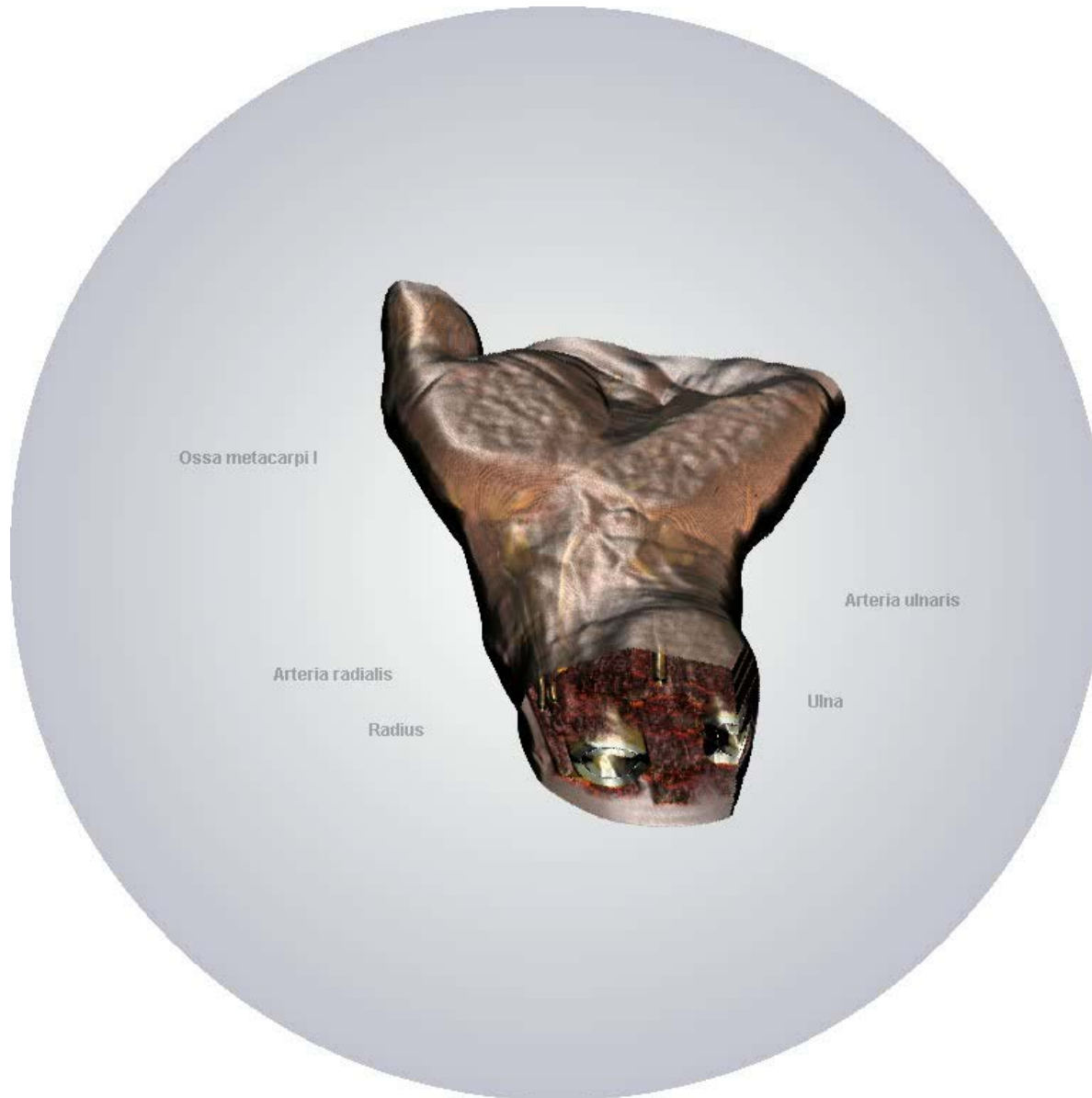
Importance-Driven Volume Rendering



Design Guidelines for Geo-Cutaways

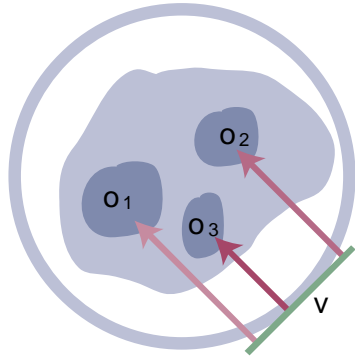


Importance-Driven Focus of Attention



Importance-Driven Focus of Attention

object-space distance weight



visibility estimation

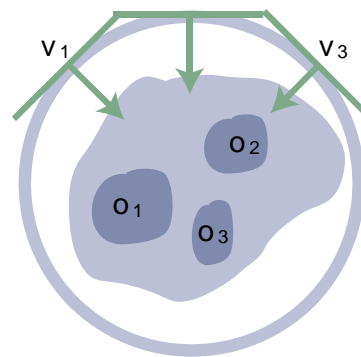
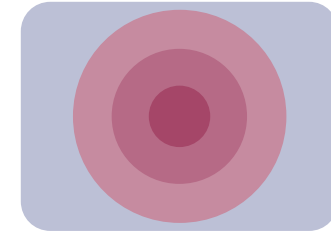
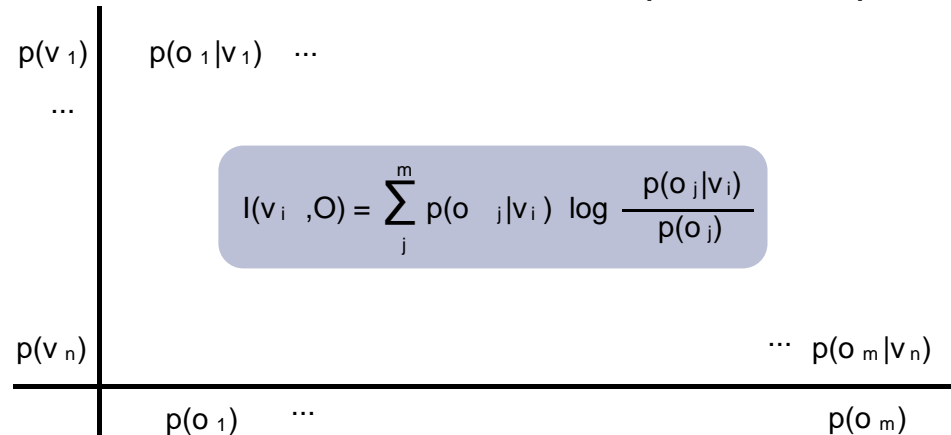


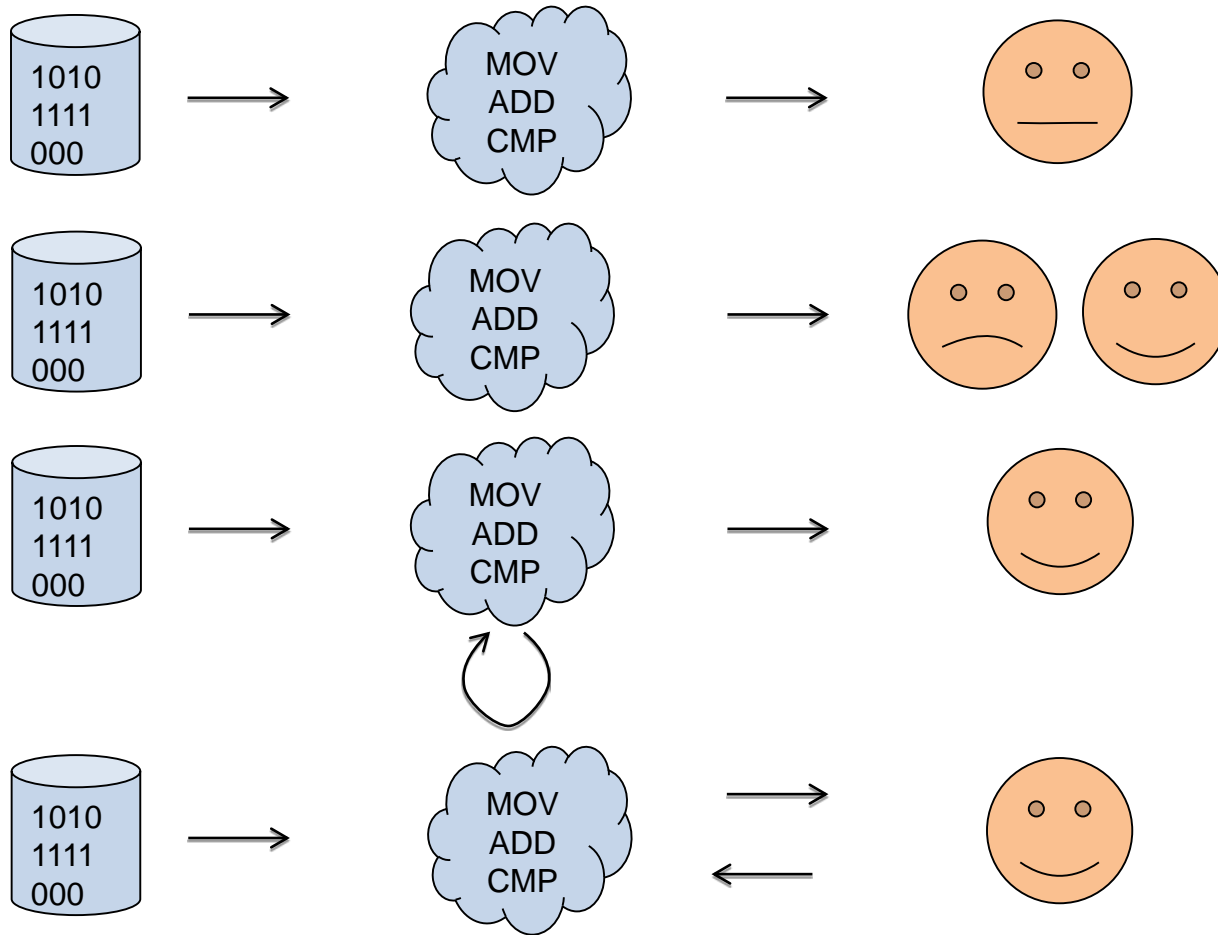
image-space weight



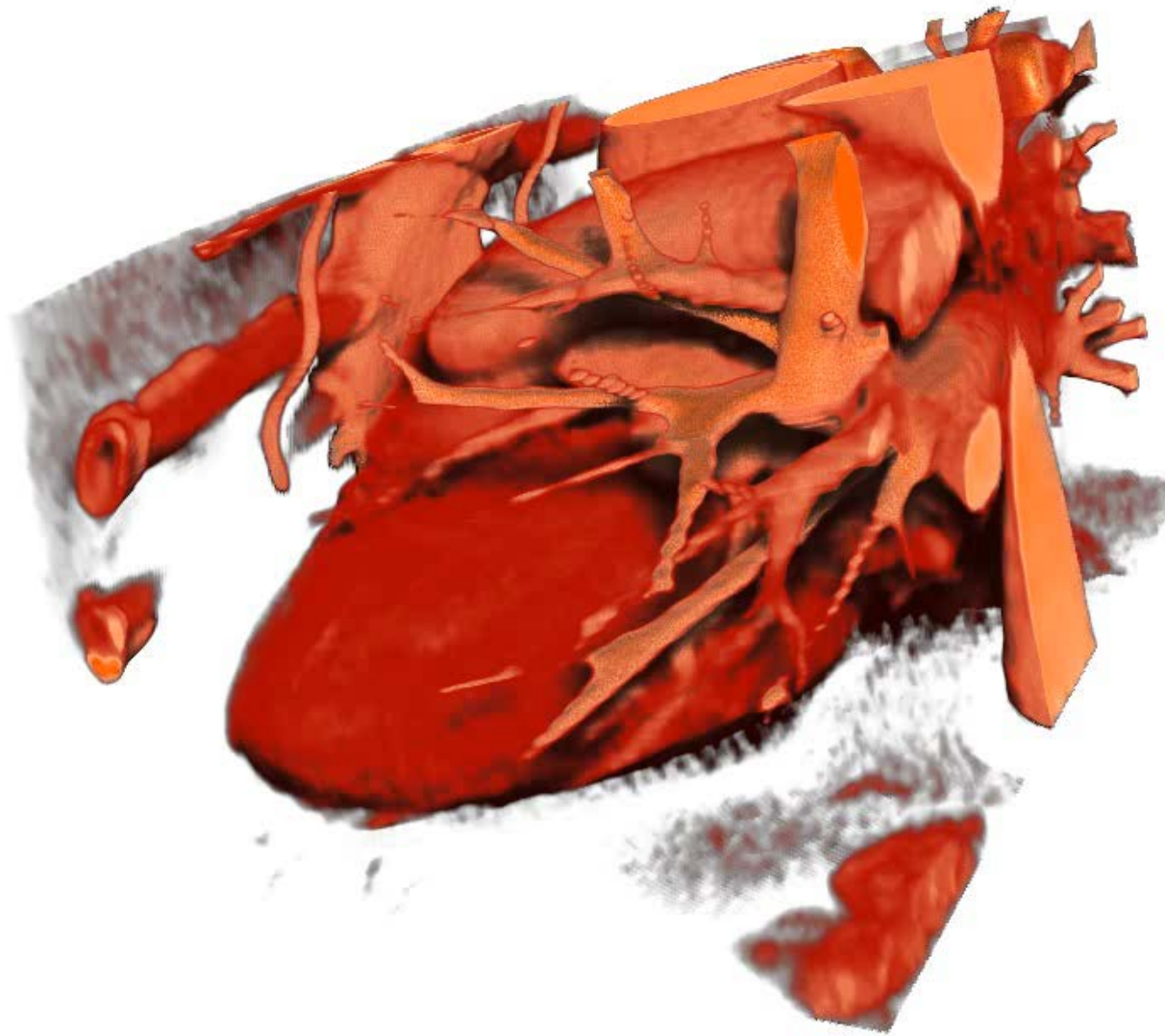
information-theoretic framework for optimal viewpoint estimation



Pipeline Patterns

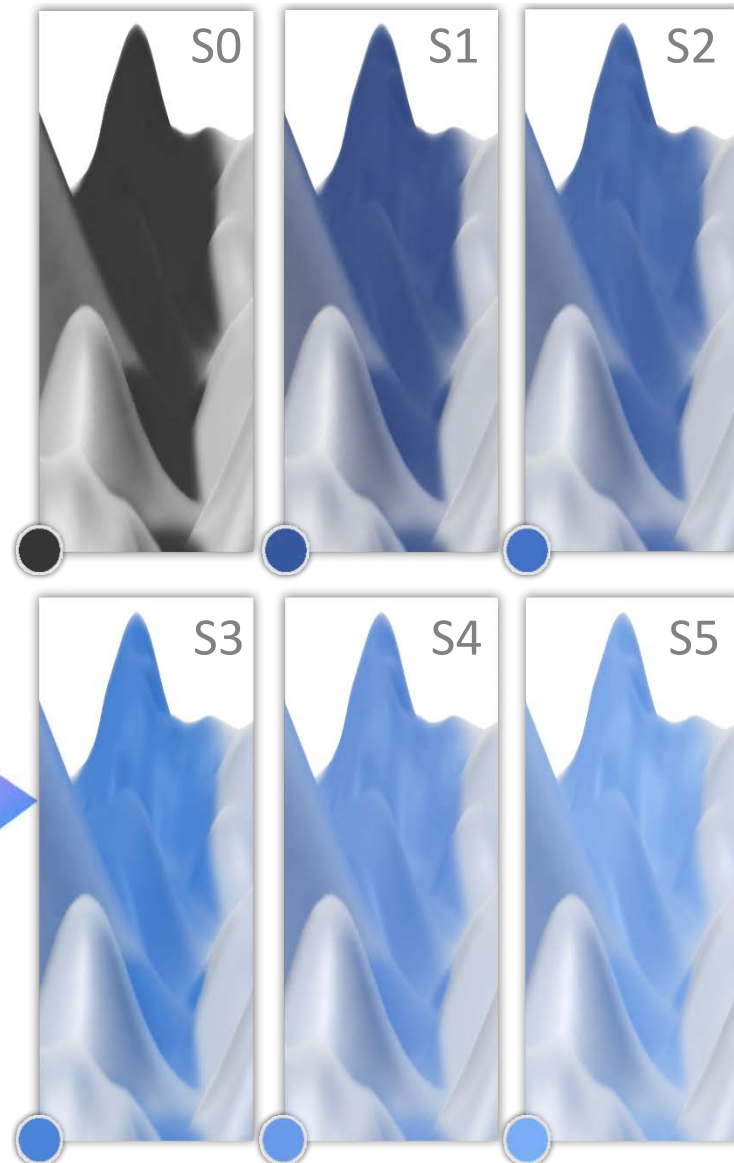
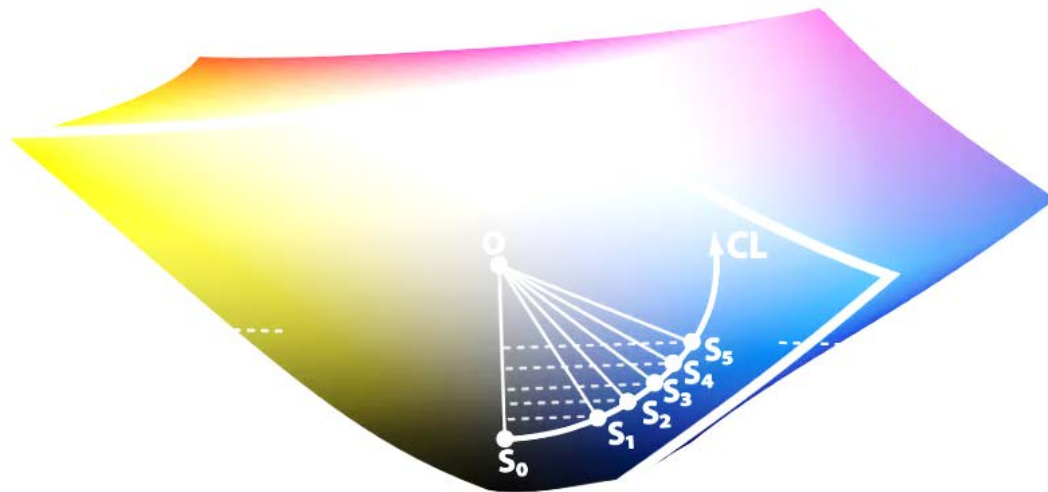


Occlusion Shading



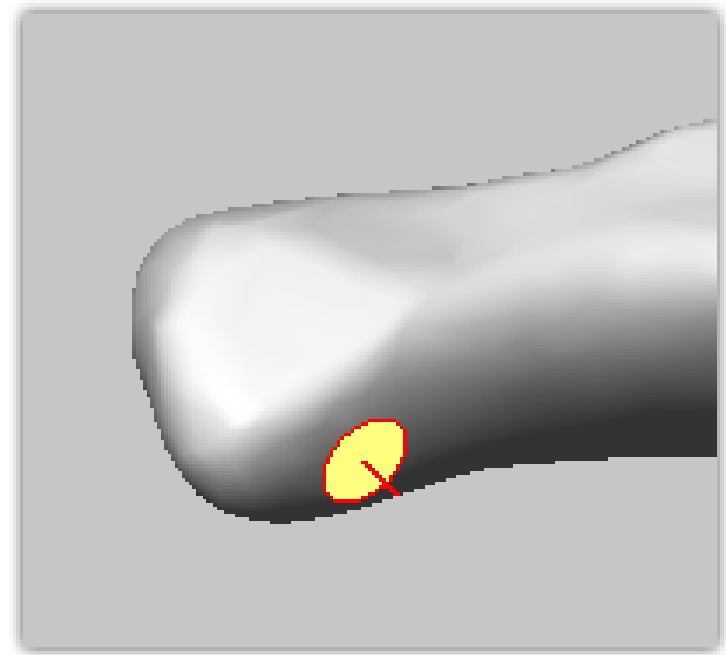
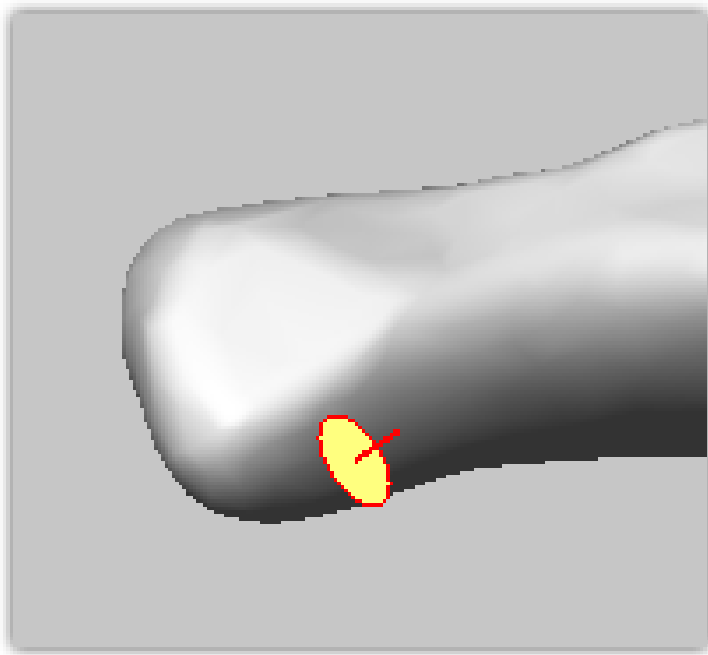
Chromatic Shadows

- Constant perceptual distance between shadow color and object color



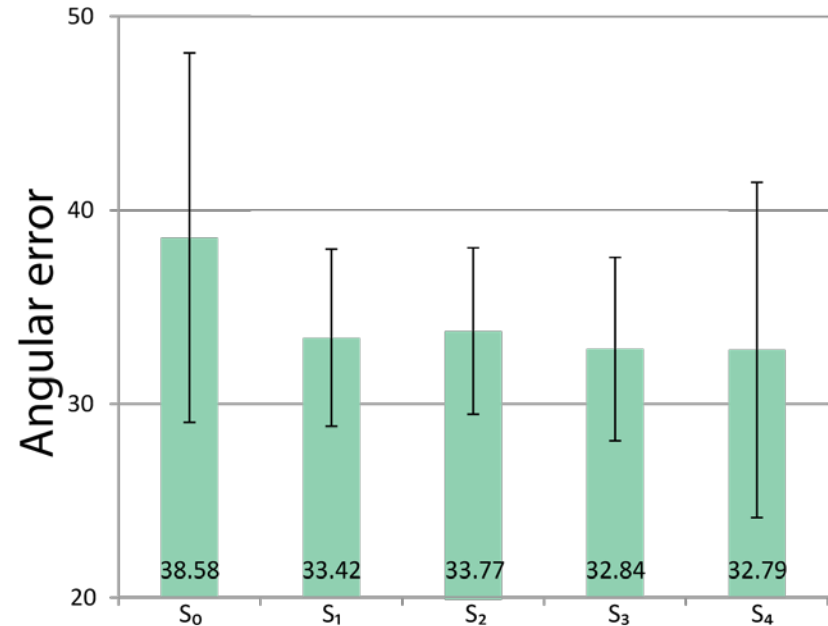
Assessment of Surface Perception

- Gauge figure task [Koenderink et al. '92]



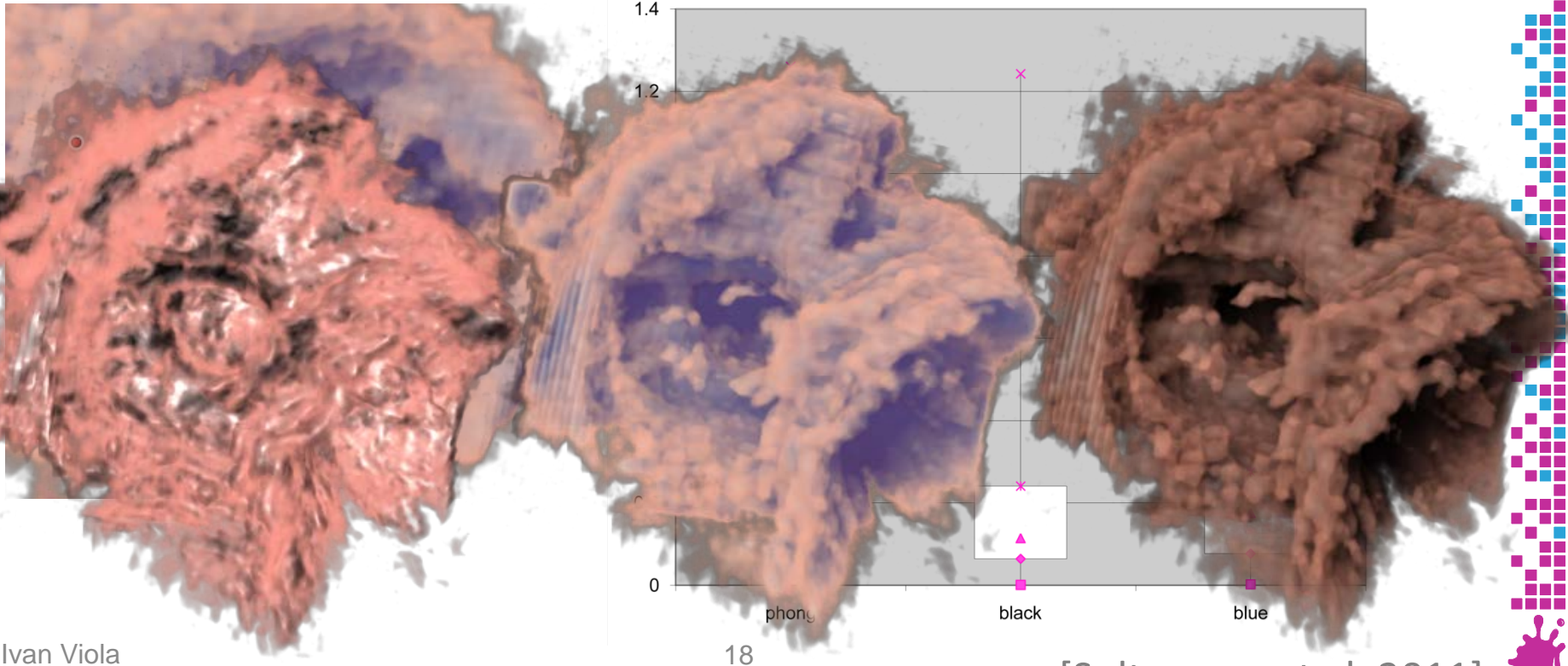
Experiment on Surface Perception

- Users rotated the gauge until it was perceived tangential to the surface
- Perceived and ground truth normal
- Tested shadow colors S0-S4 from the palette



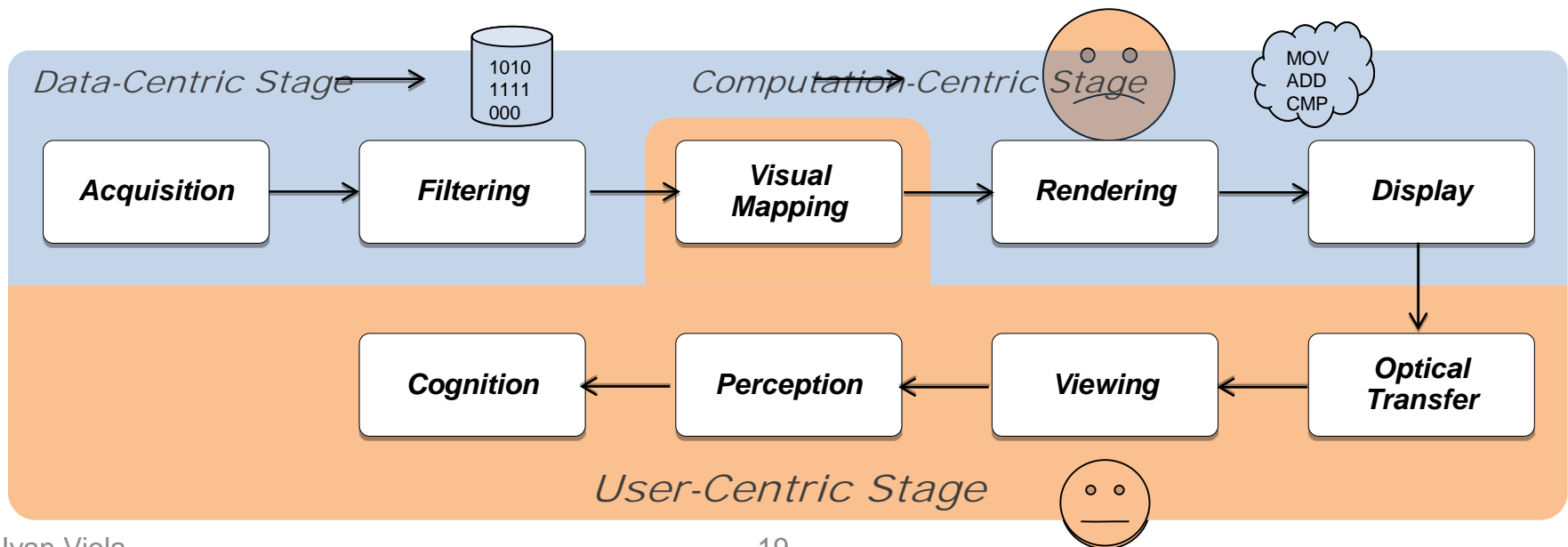
Experiment on Depth Perception

- Relative depth estimation of a yellow point with respect to the red and blue point

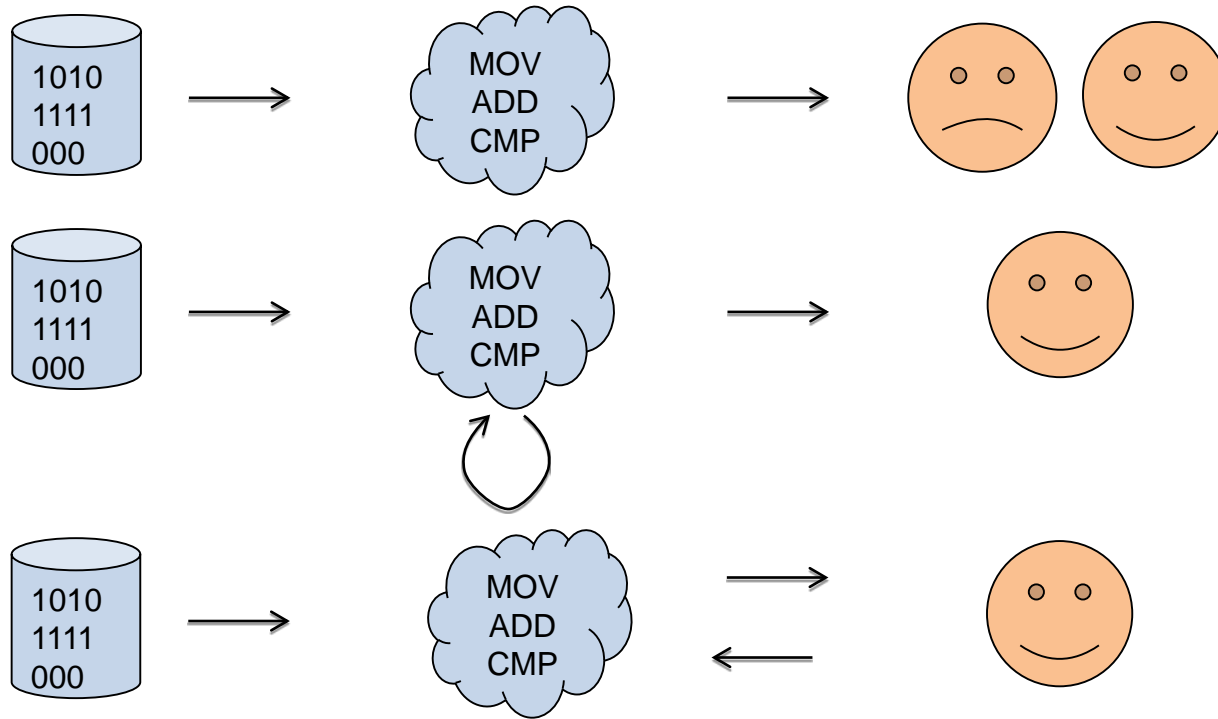


Traditional Role of Evaluation

- Final visual design is at the end evaluated
- The outcome can be...
 - positive or
 - negative...



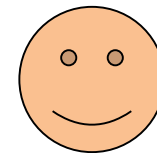
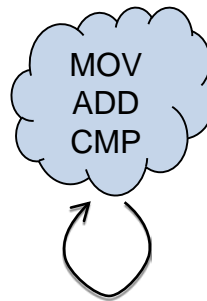
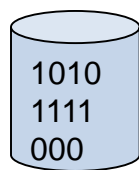
Pipeline Patterns



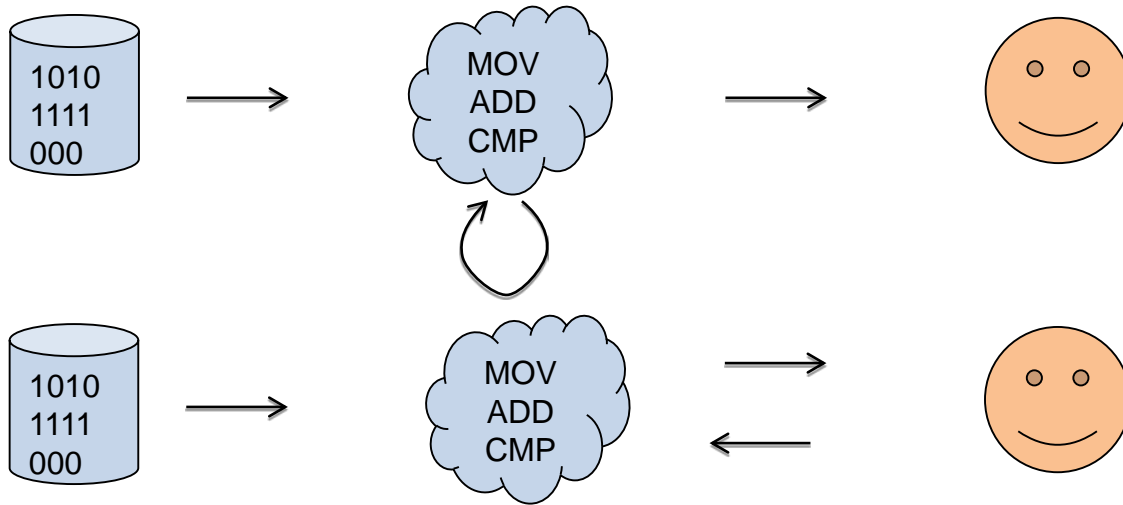
Importance-Driven Visibility



$rind = 0.25$; $transferOfColor = 0.6$; $strength = 0.15$

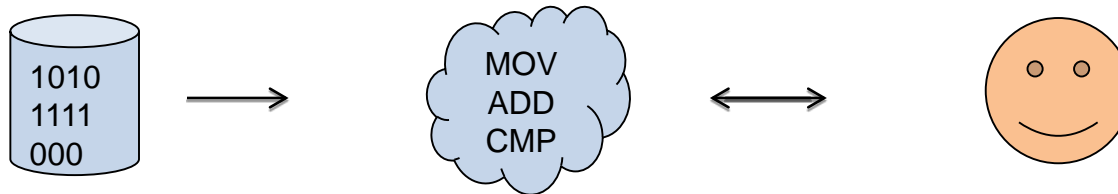


Pipeline Patterns

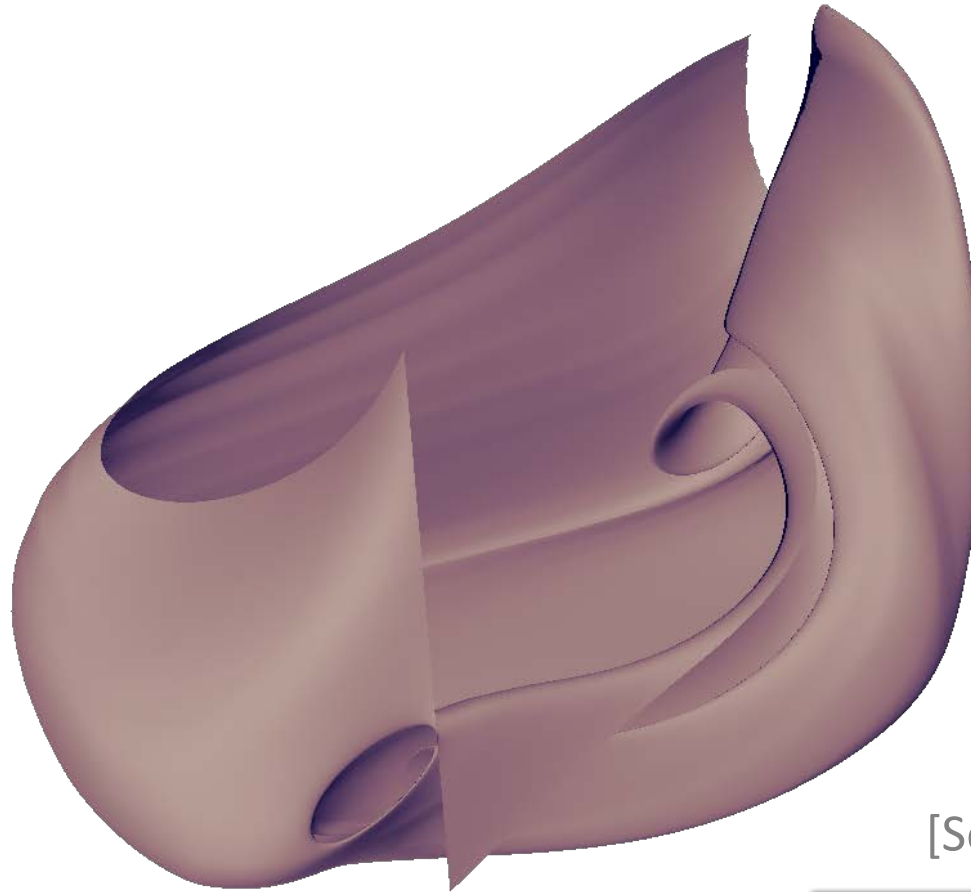


Iterative Visualization Redesign

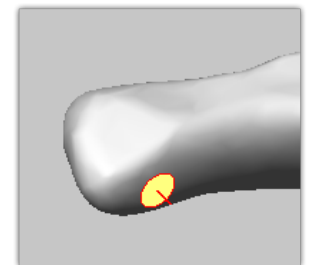
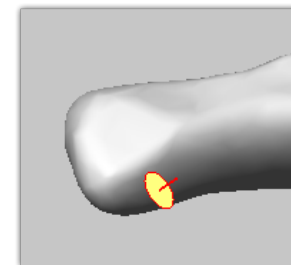
- The goal is to provide most accurate match between information and its perceptual stimulus
- Iterative approach of visualization redesign



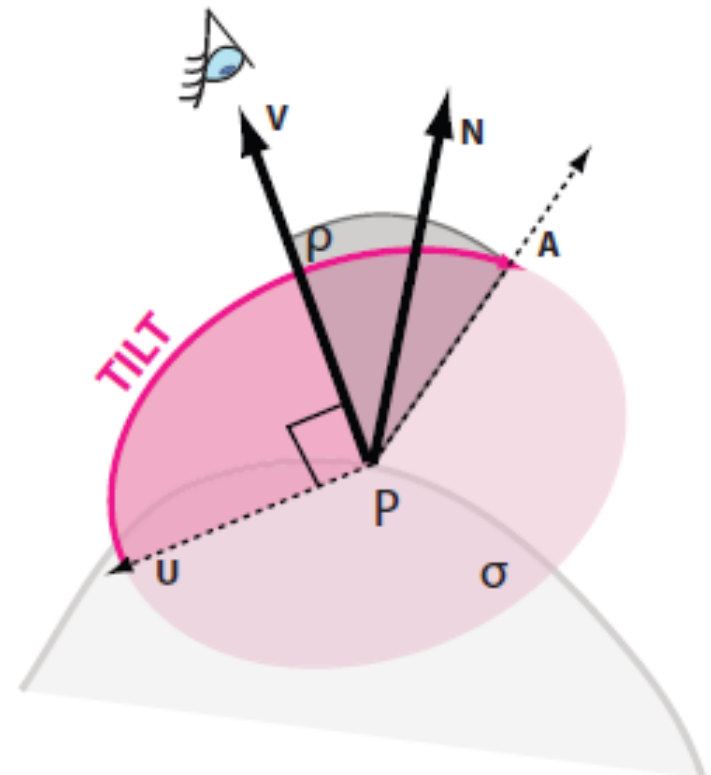
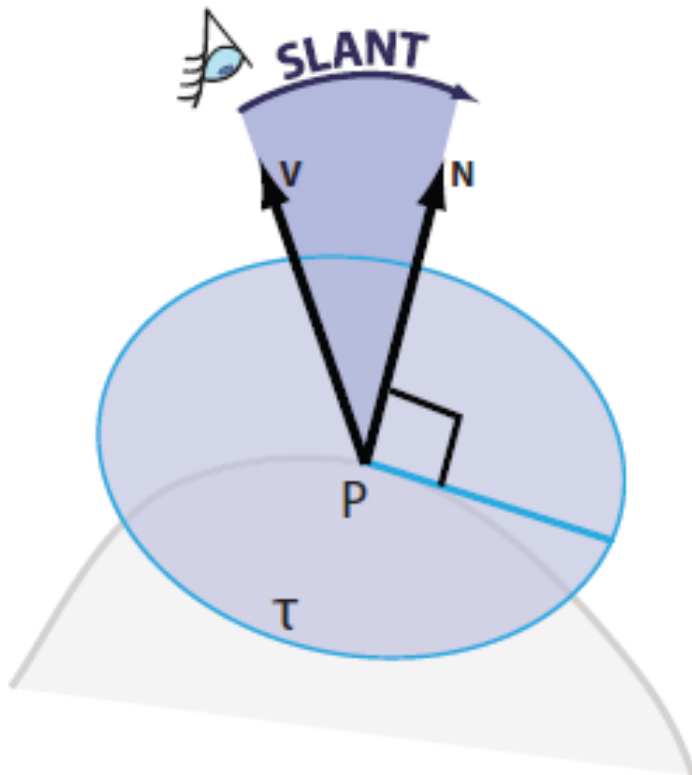
Perceptual-Statistics Shading Model



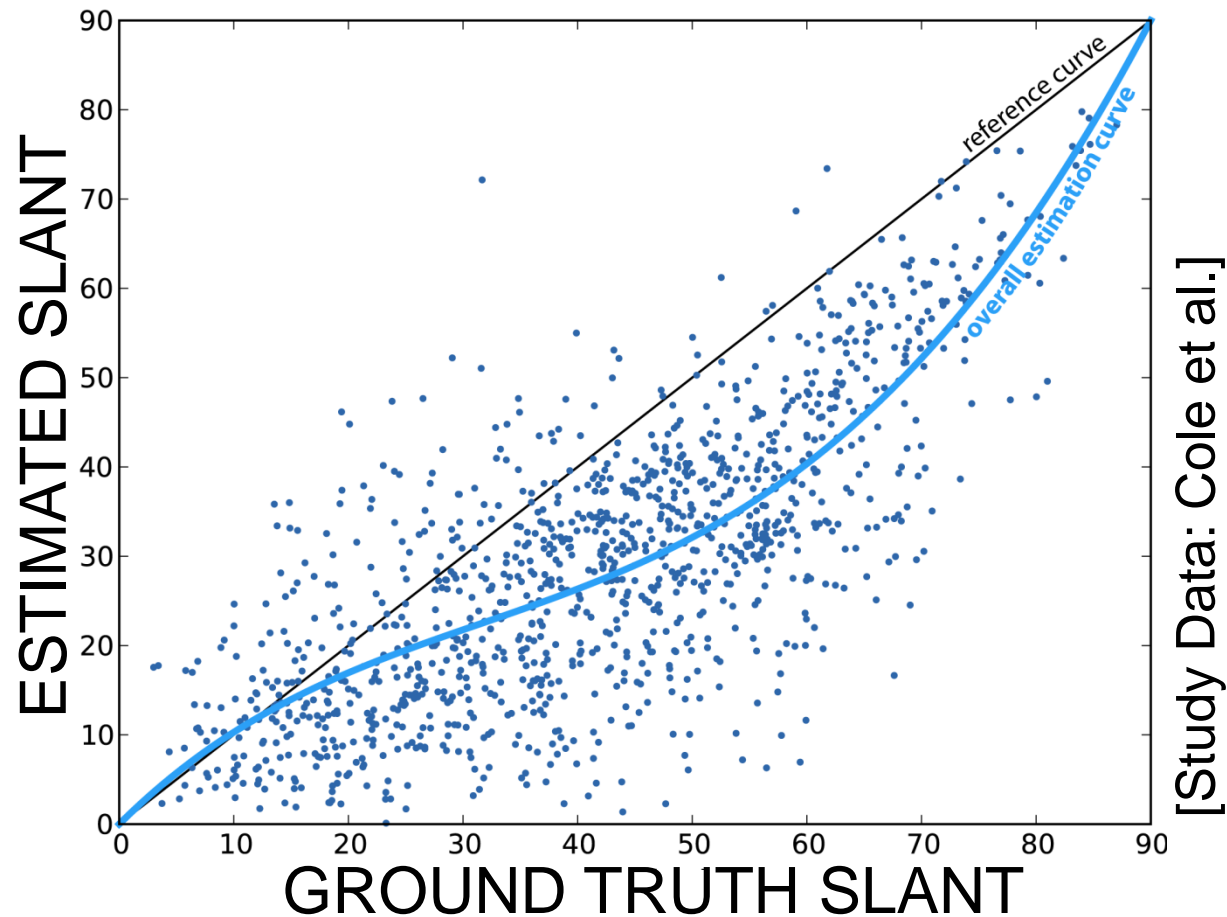
[Solteszova et al. 2012]



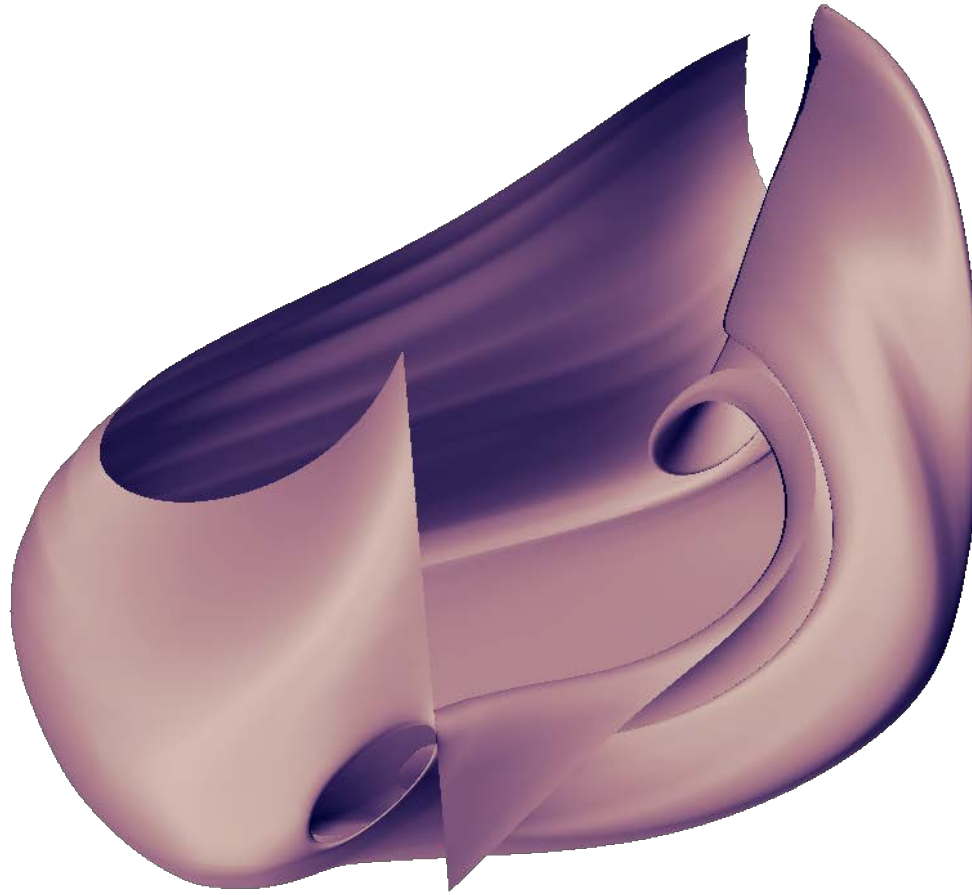
Surface Slant and Tilt



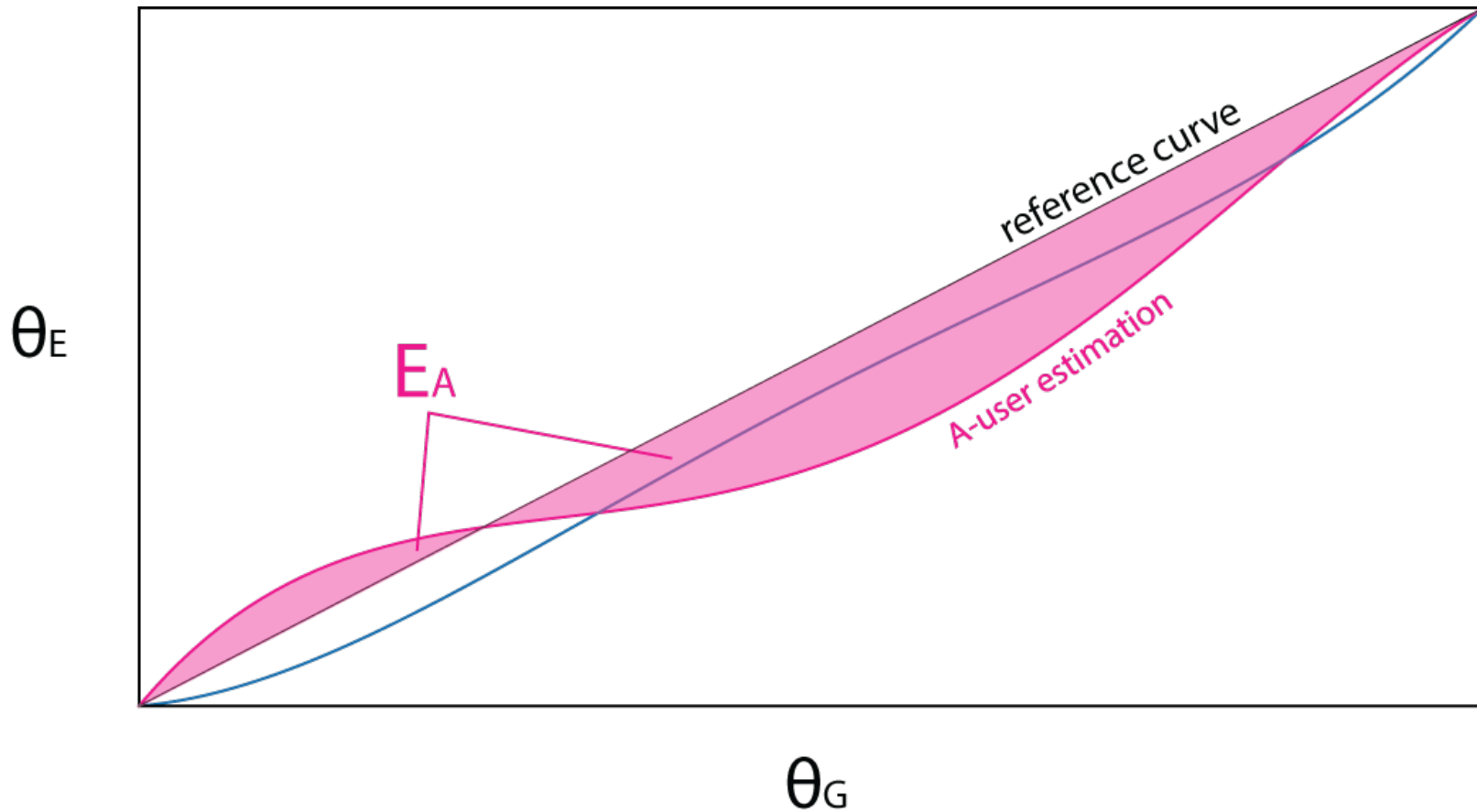
Underestimation of Slant



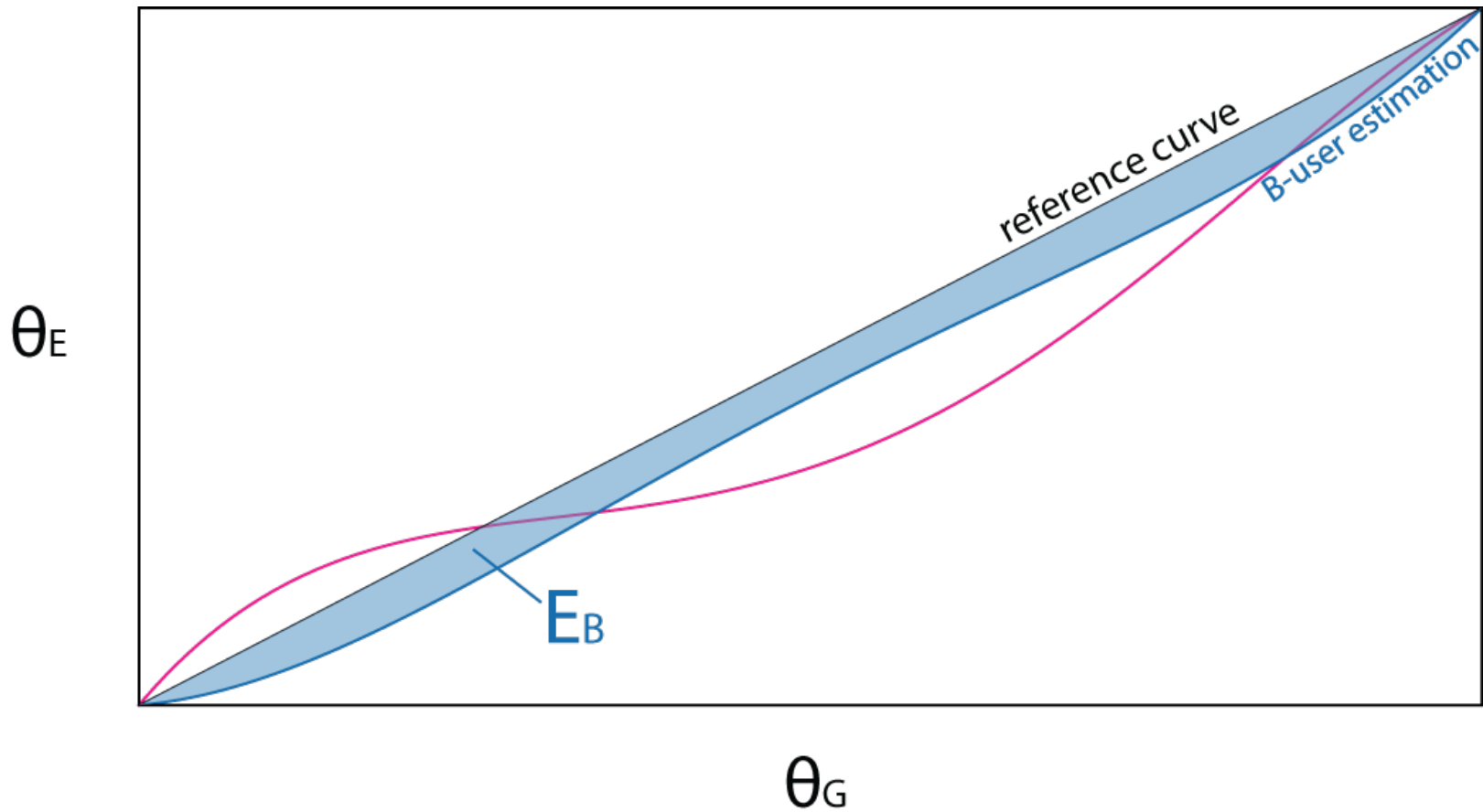
Optimized Normal-Based Shading



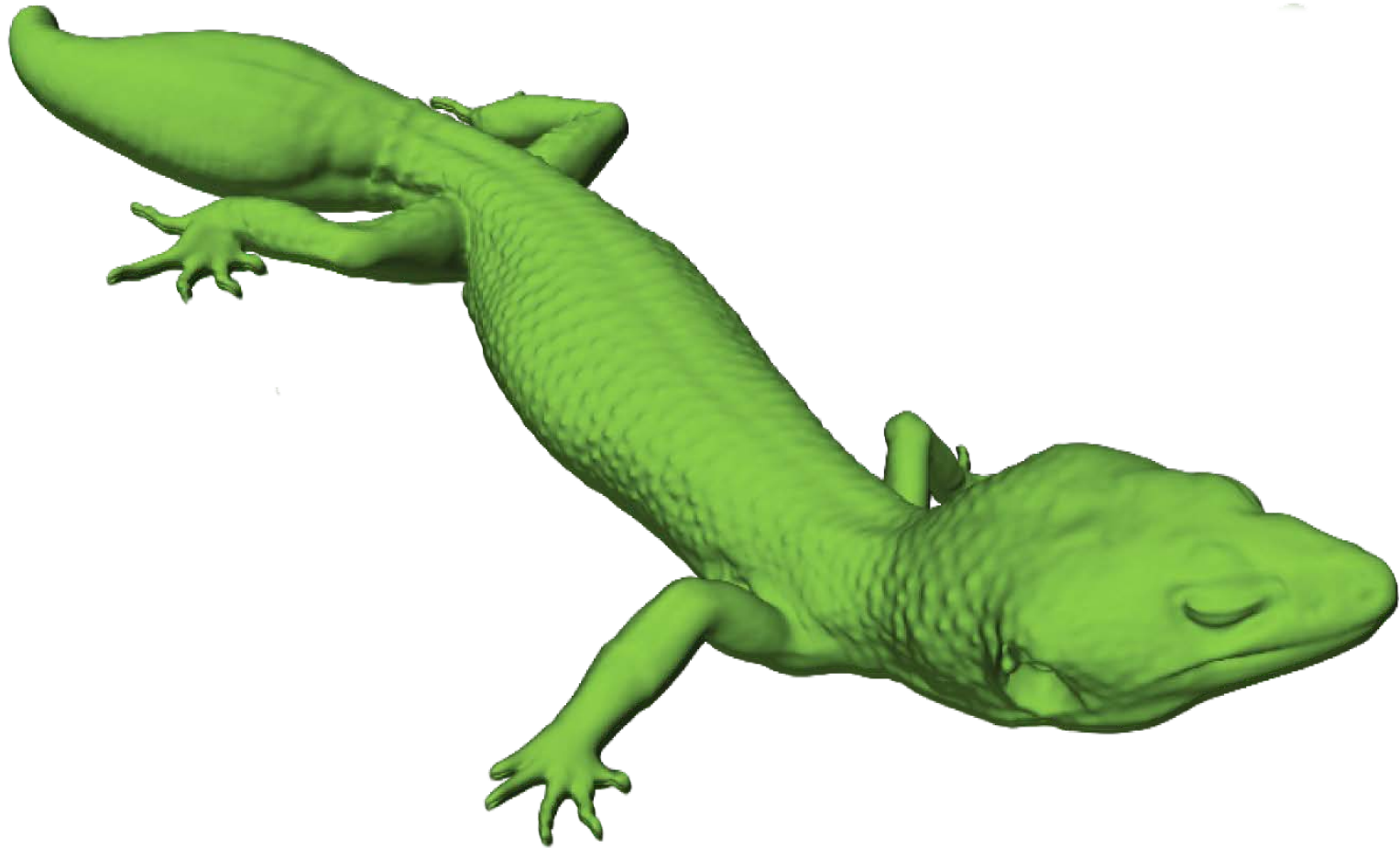
Quantifying the Error



Quantifying the Error

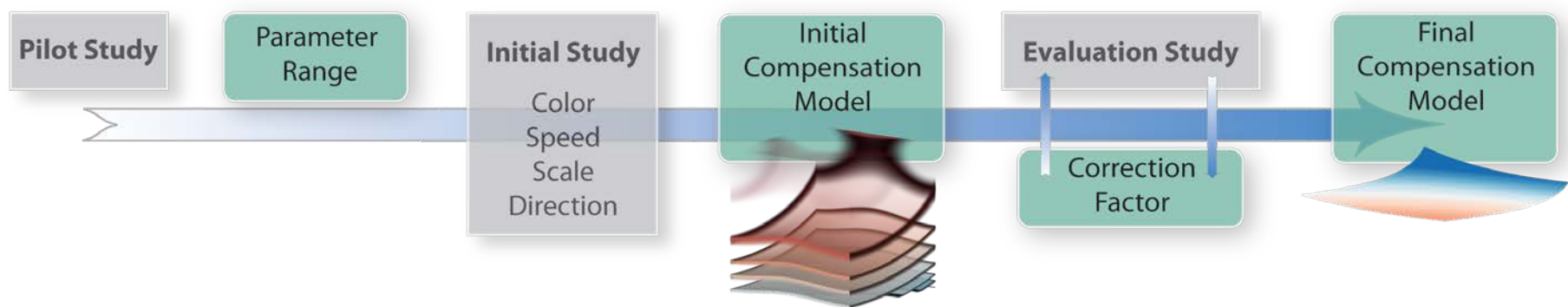
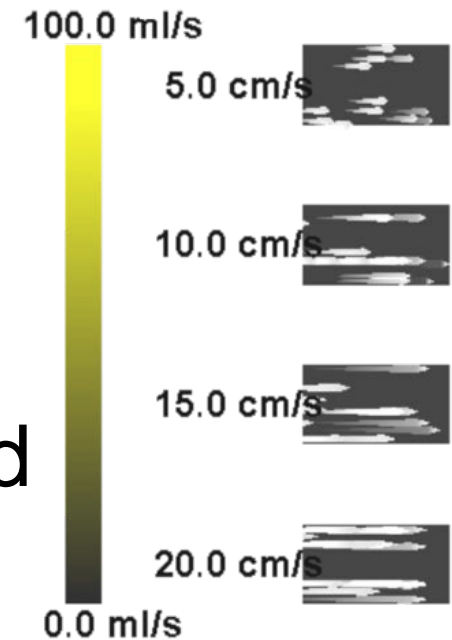


Iterative Evaluation and Redesign



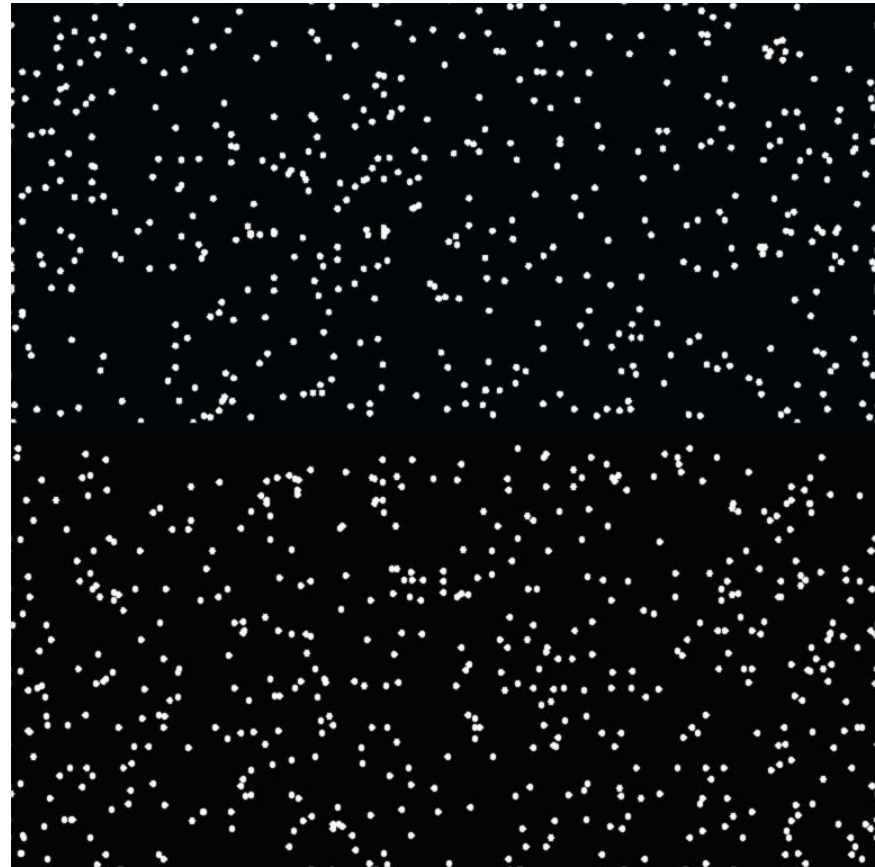
Perceptually Uniform Motion

- How is motion perceived in relation of one to another?
- Can we linearize perception of motion?
- Estimation from a motion legend



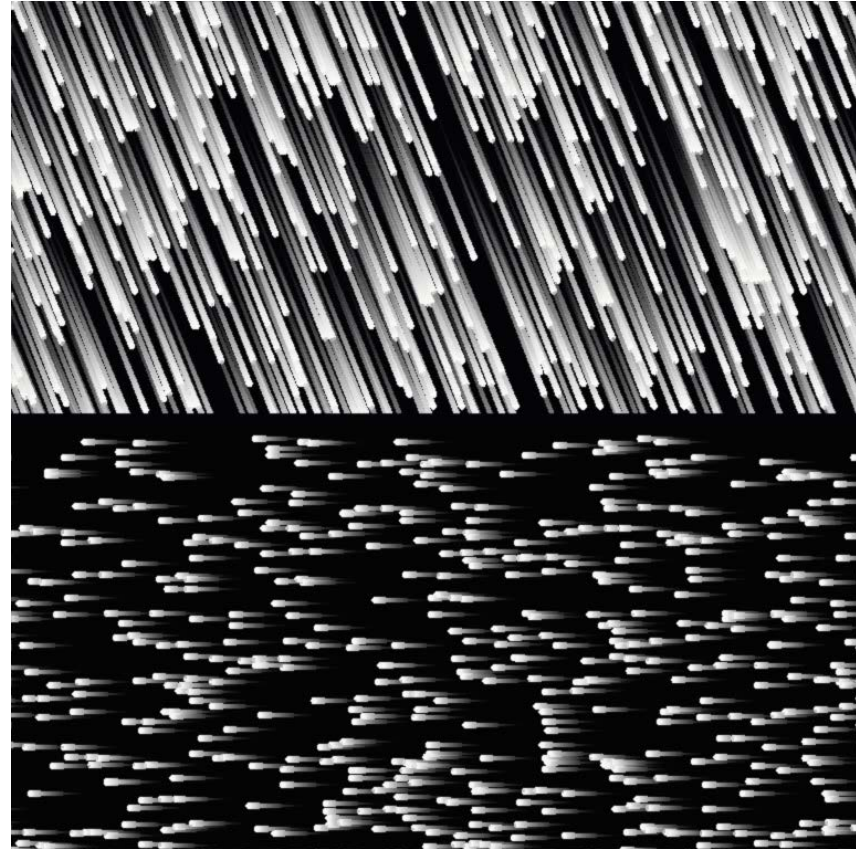
Studied Characteristics

- Task: Estimate relative speed-up factor
- Global scale of velocities
- Direction
- Contrast-type
- Representation



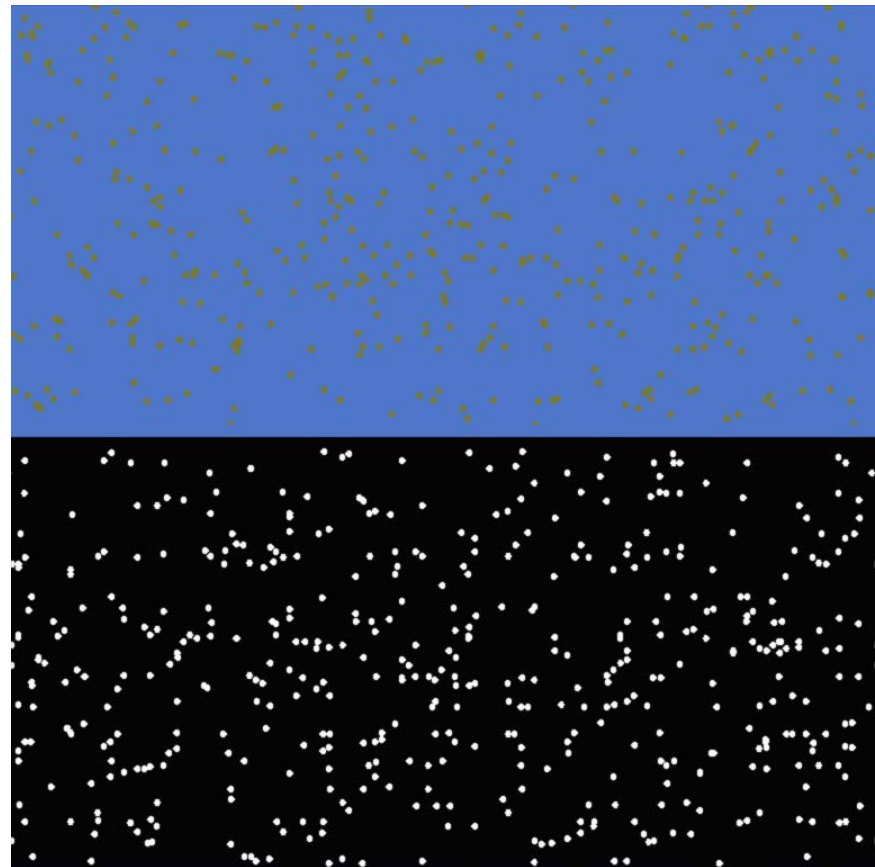
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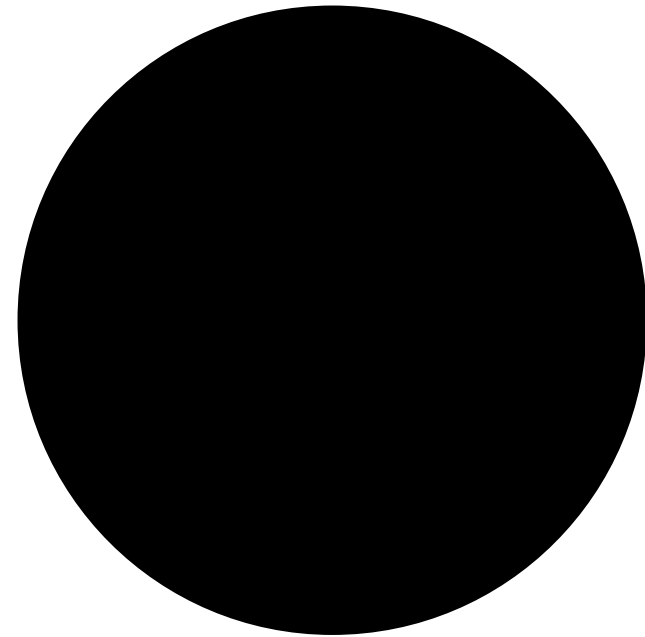
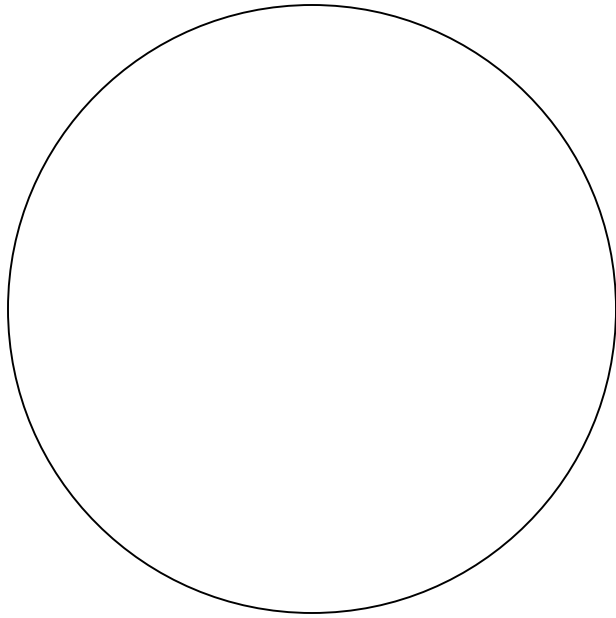


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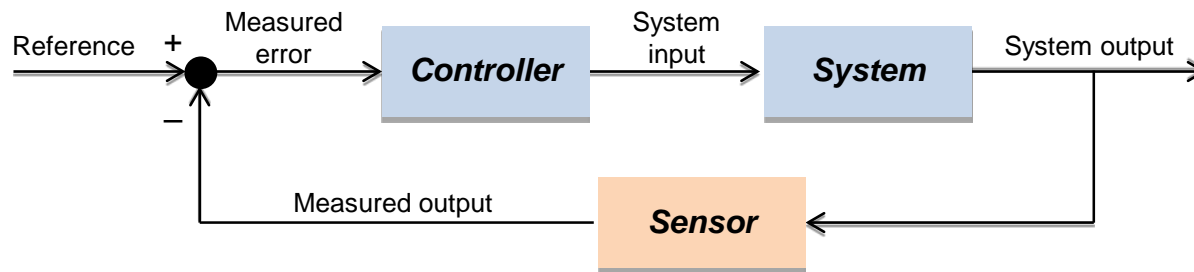
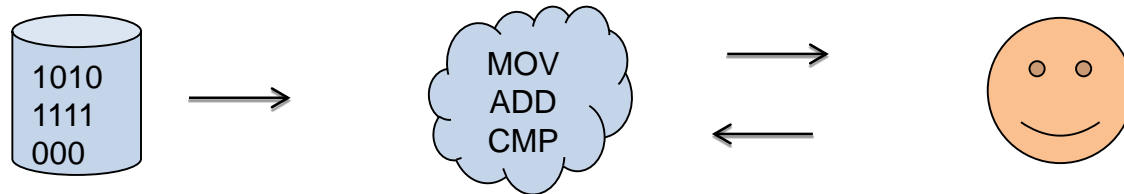


Information Visualization: Circle Size



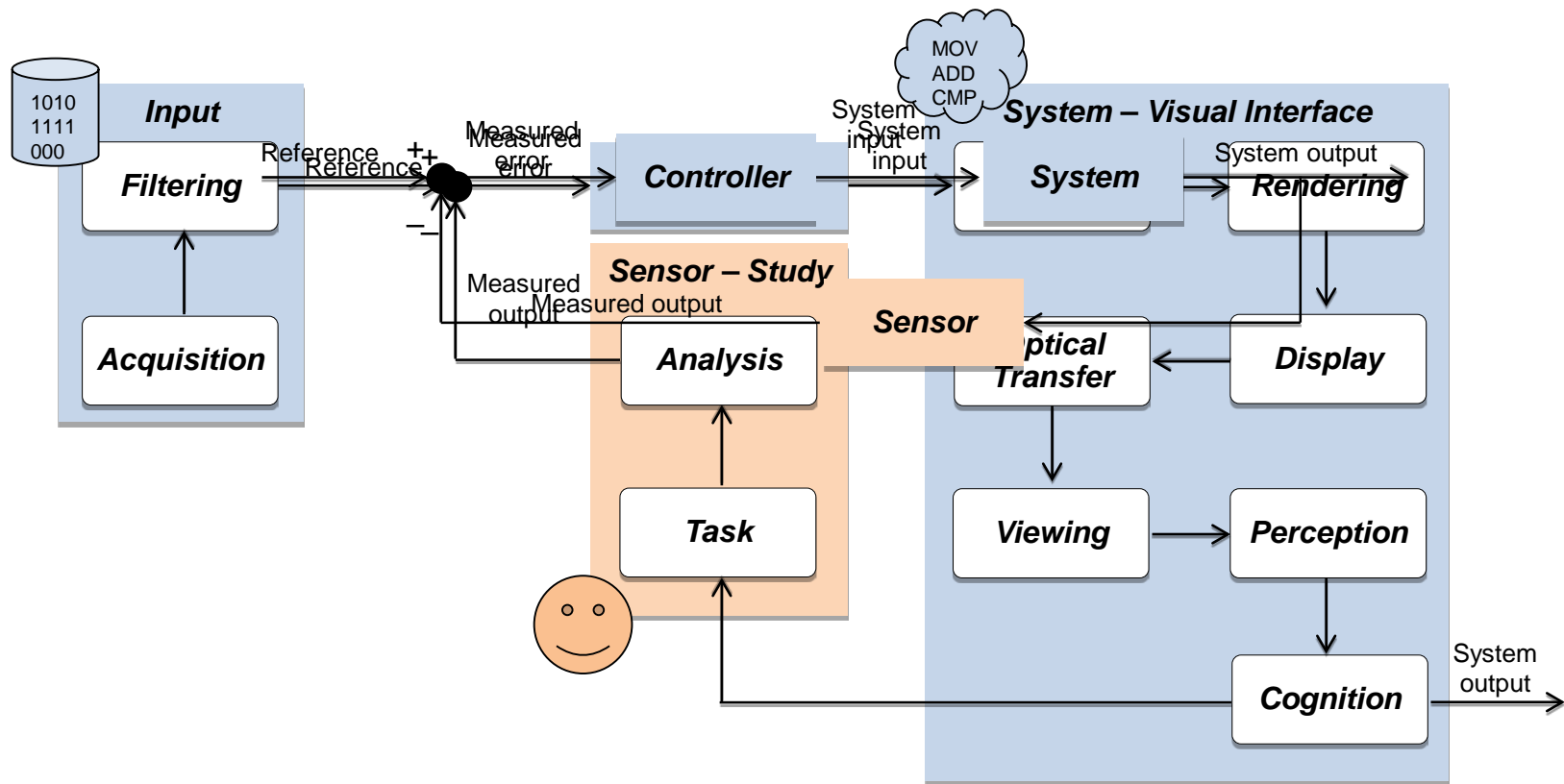
Declarative Visualization Workflow

- Automation and regulation systems are based on a feedback loop mechanism



Declarative Visualization Workflow

- Can we learn from process automation?
- What would the PID controller look like?



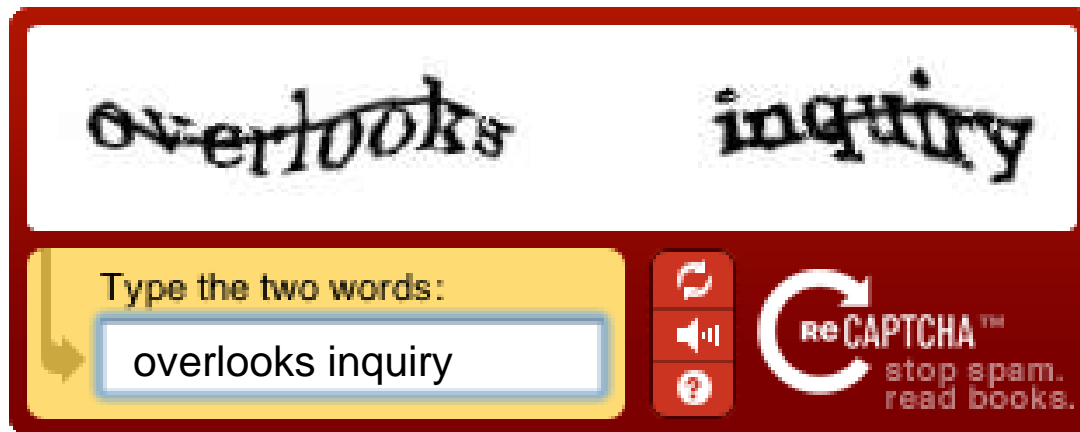
Sensor

- Psychophysics
- Controlled Study
- Surveillance
 - Eye Tracking (Tobii)
 - Digital Pen (Lifetrans)
 - EEG (Emotiv)
- Crowdsourcing
- Statistical Analysis
- Individuality is reality

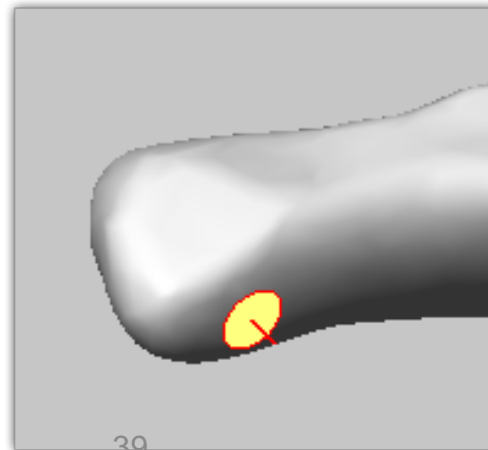
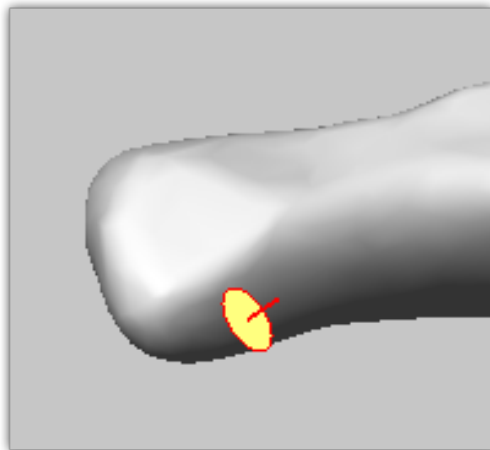


Invisible Perceptual Study

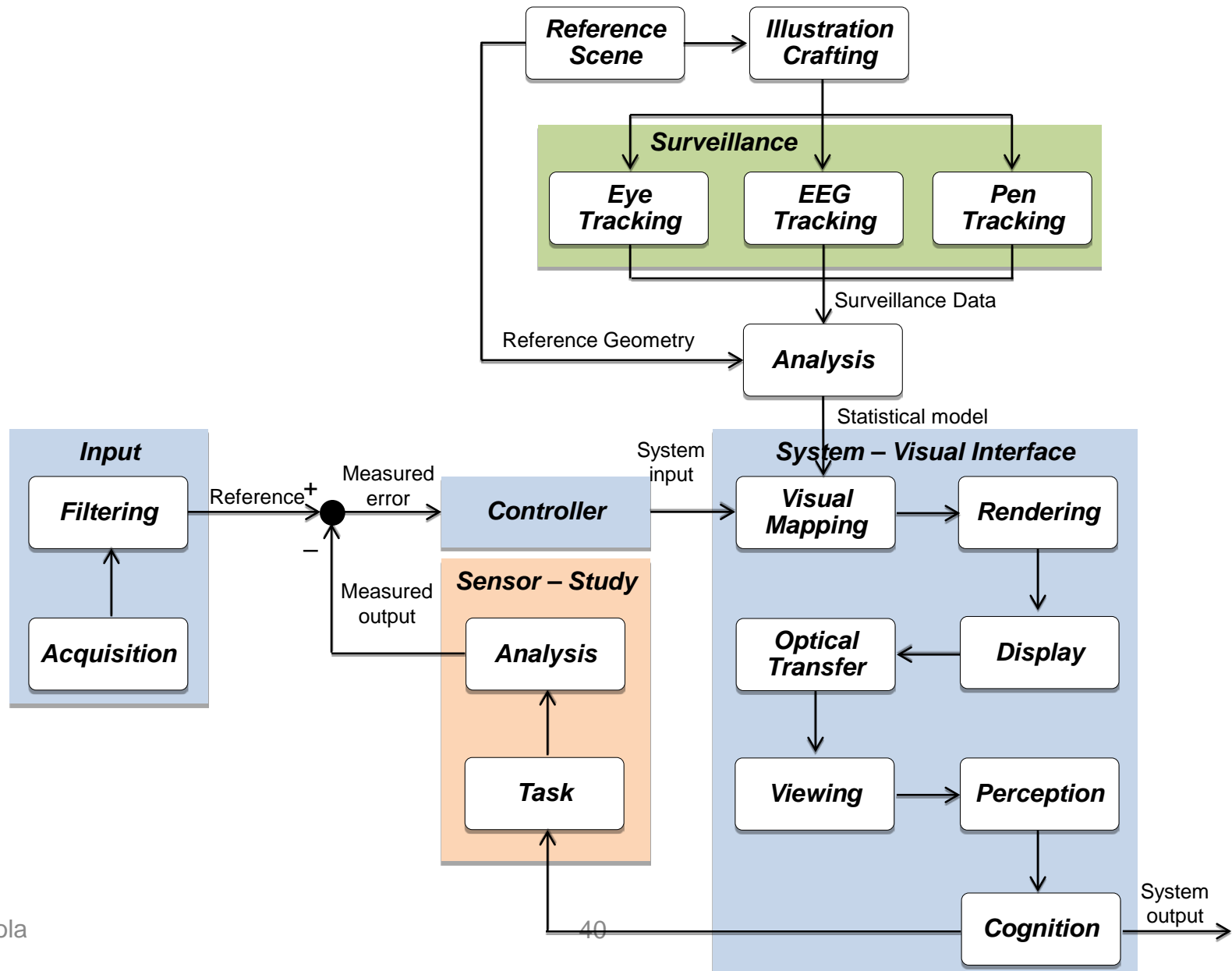
- ReCaptcha idea



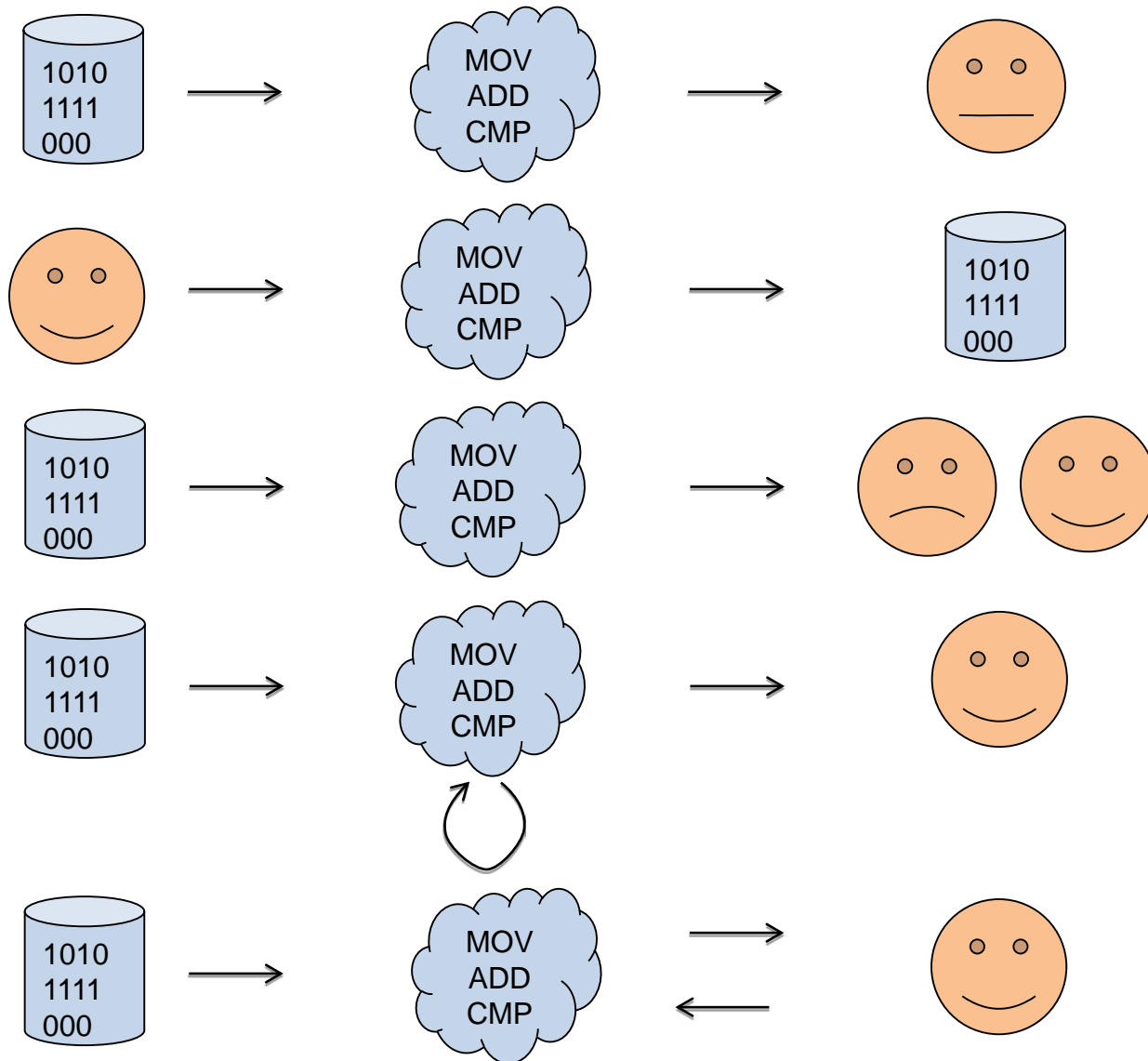
- ReGauge-figure task?



Statistical Model of Illustration



Pipeline Patterns



Thanks

- Veronika Šoltészová
- Åsmund Birkeland
- Endre Lidal
- Manu Waldner
- many others!



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