Some Examples of Computer Vision Methods for Computer Animation: Hair Modeling and Motion Reconstruction From Few Sensors

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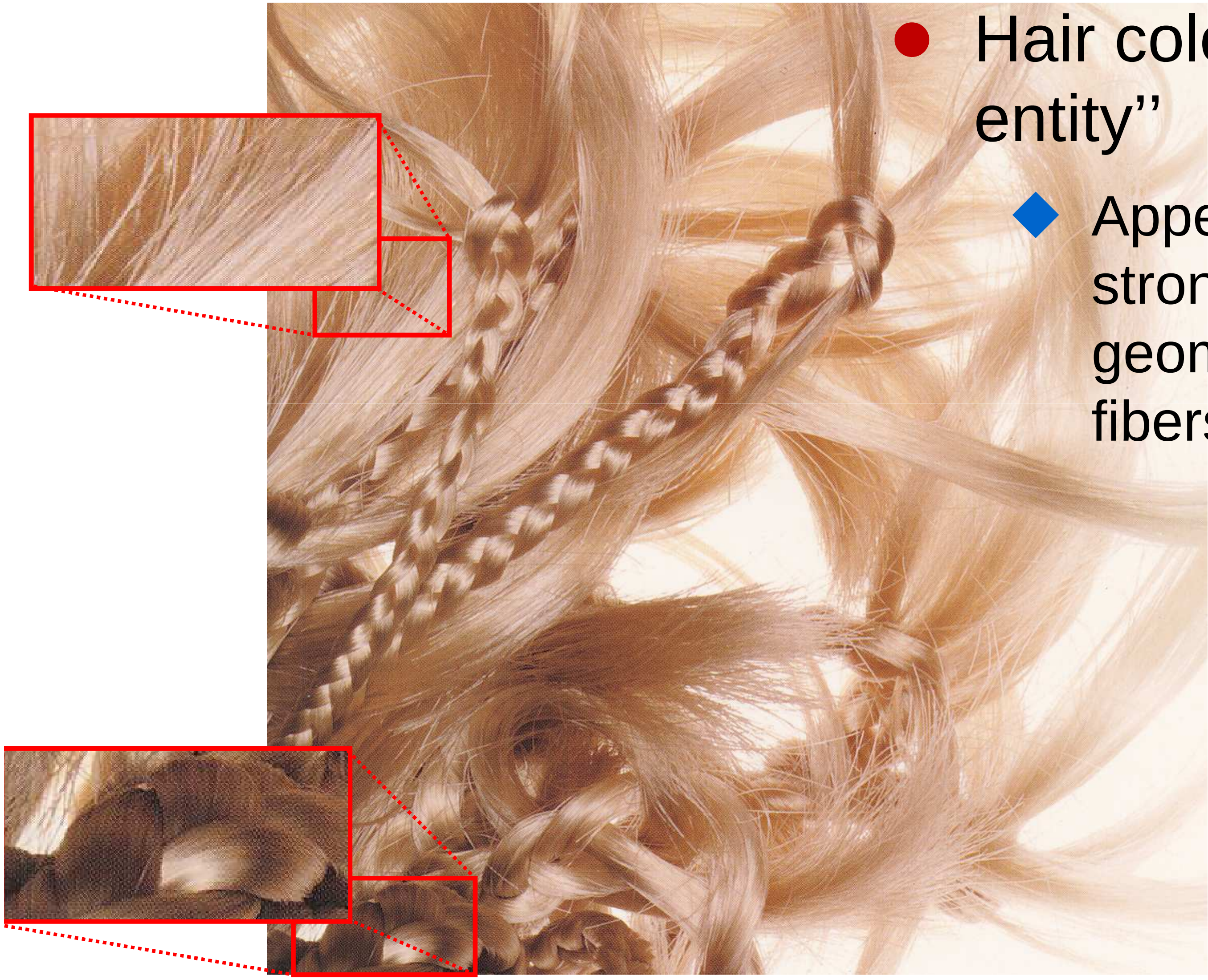
Photometric Acquisition of Hair Color

Photometric Acquisition of Hair Color

- Work in the context of our hair modeling activities
  - Involving Hair style modeling, dynamic simulation of hair, and rendering
  - Inverse problems are now in the focus of our research
    - Quite some progress has been made in the fields of geometric and optical simulations
- Recent publication in ACM Transactions on Graphics (SIGGRAPH Asia 2009)
    - A. Zinke et al.: A Practical Approach for Photometric Acquisition of Hair Color

Photometric Acquisition of Hair Color



- Hair color is an ``ill defined entity''
  - Appearance of a hair fiber strongly depends on geometry and neighboring fibers

Photometric Acquisition of Hair Color

- Modeling of the optical properties of hair in PhD-thesis work of Arno Zinke
  - Single fiber scattering
    - 8-dimensional BFSDF and the simplified 4-dimensional BCSDF
  - Multiple scattering

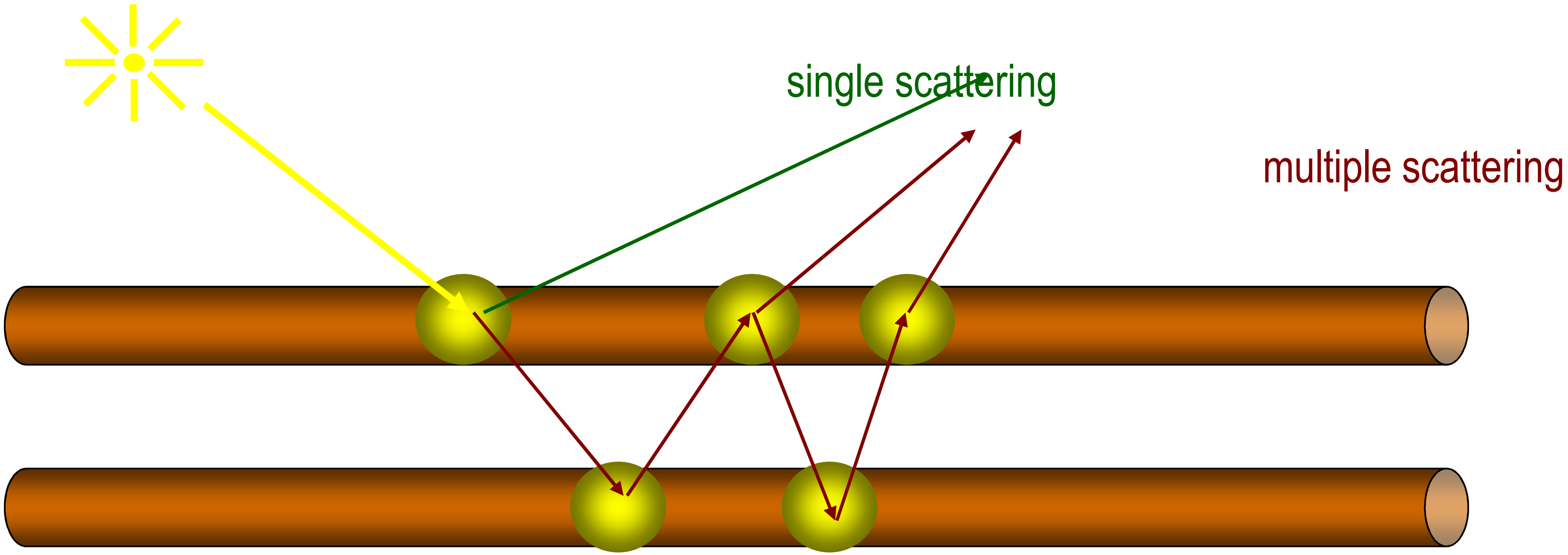
- Acquisition of hair color
  - Estimating the parameters of an average BCSDF of the fiber assemblies

Photometric Acquisition of Hair Color

- Major problems
  - Complicated effects on the scattering of one fiber
    - Caustics, narrow peaks
  - Strong interaction between geometry and optical properties
- Solutions
  - Use specific hair geometries
    - Which are suitable to exhibit the parameters
    - Curl hair around a cylinder
  - Use specific analysis of the rendering models
    - Involving single and multiple scattering

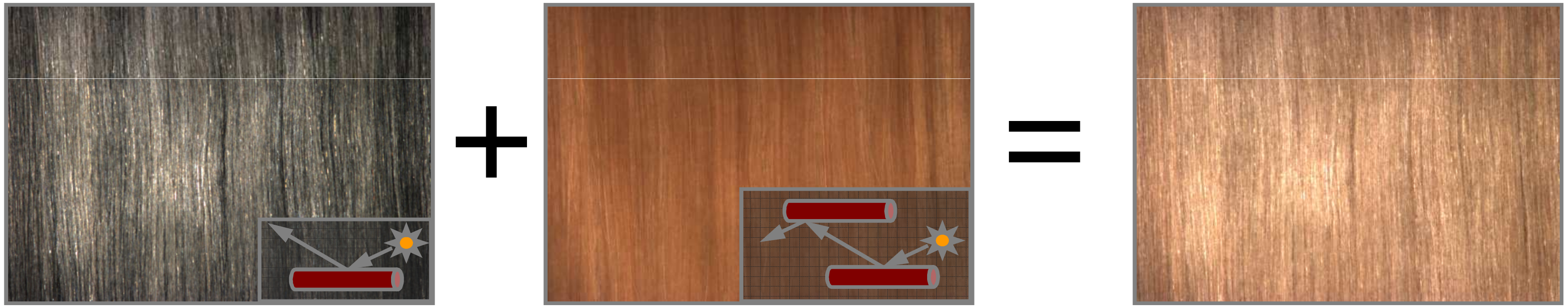
Understanding Hair Color

- Components: single & multiple scattering



Understanding Hair Color

- Multiple scattering is essential for the hair color

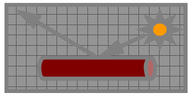


single scattering + multiple scattering =

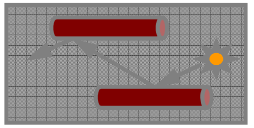
measurements: Nayar et al.

Single vs. Multiple Sattering

- Single scattering is **local**
  - Only local structure of a hair strand needs to be known



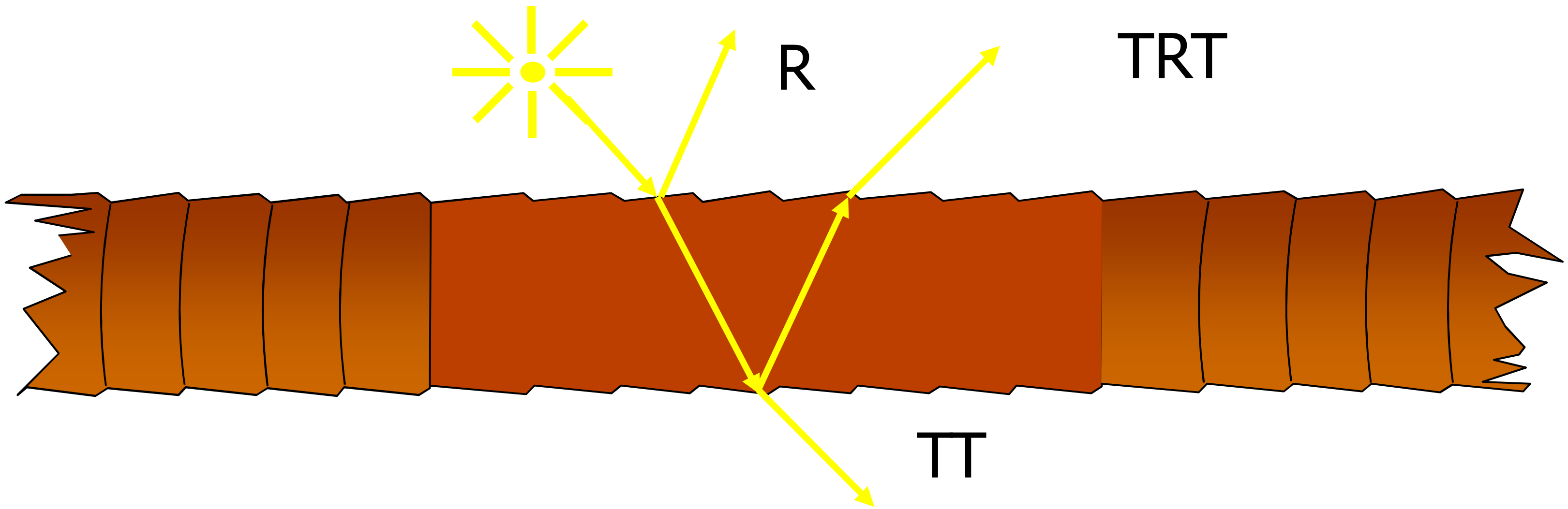
- Multiple scattering is **global**
  - Light scatters inside the hair volume



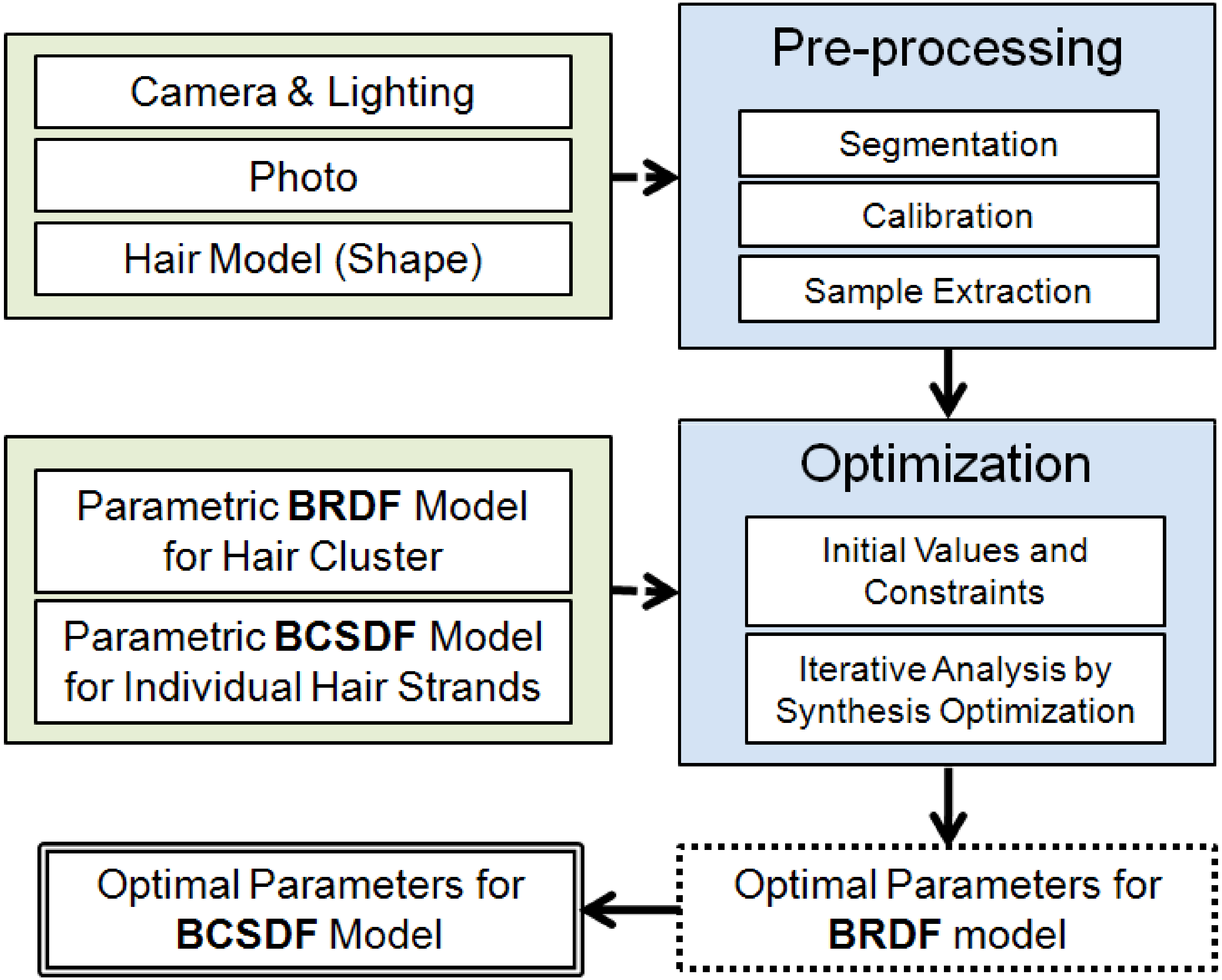
- Multiple scattering is successive single scattering
  → Single scattering is the key to the full solution

Basic Single Scattering Model for Hair

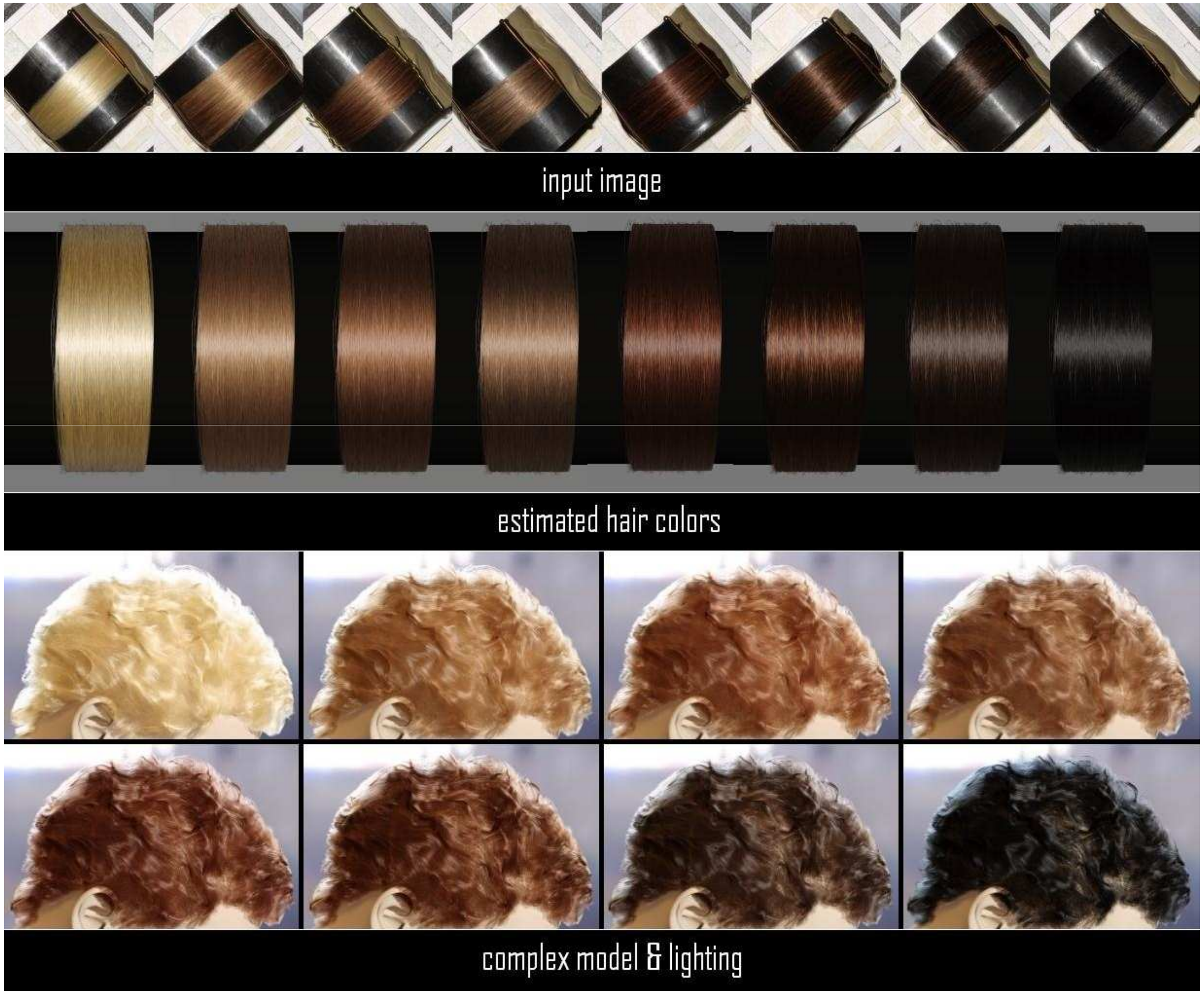
- Colored glass cylinder with surface scales
- Three scattering components:
  - Direct surface reflection: R
  - Two times transmitted: TT
  - Transmitted – internally reflected – transmitted: TRT



Photometric Acquisition of Hair Color



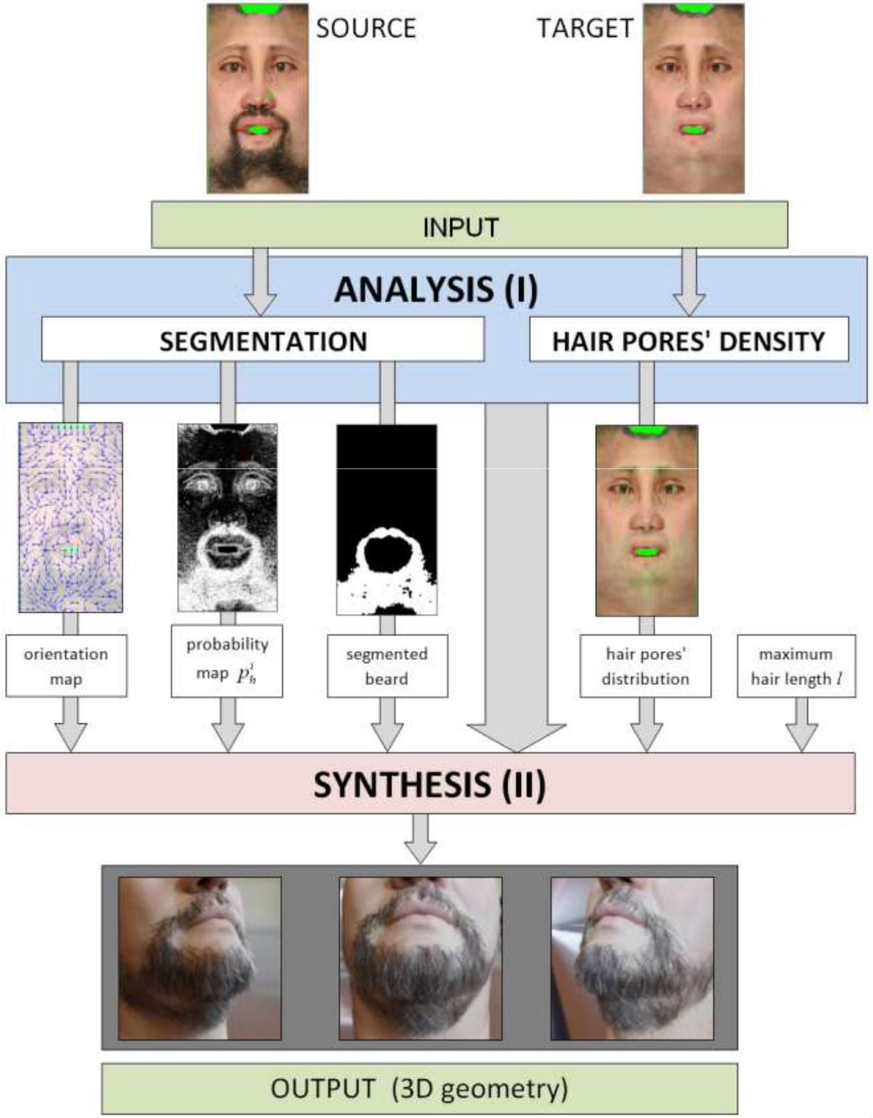
Photometric Acquisition of Hair Color



Towards Image Based Beard Modeling

Towards Image Based Beard Modeling

- Mainly work in the PhD project of Tomas Lay
  - Joint work with
    - Arno Zinke
    - Thomas Vetter (Basel)
- See also Poster



Towards Image Based Beard Modeling

- Some results

Motion Reconstruction From Few Sensors

Motion Reconstruction From Few Sensors

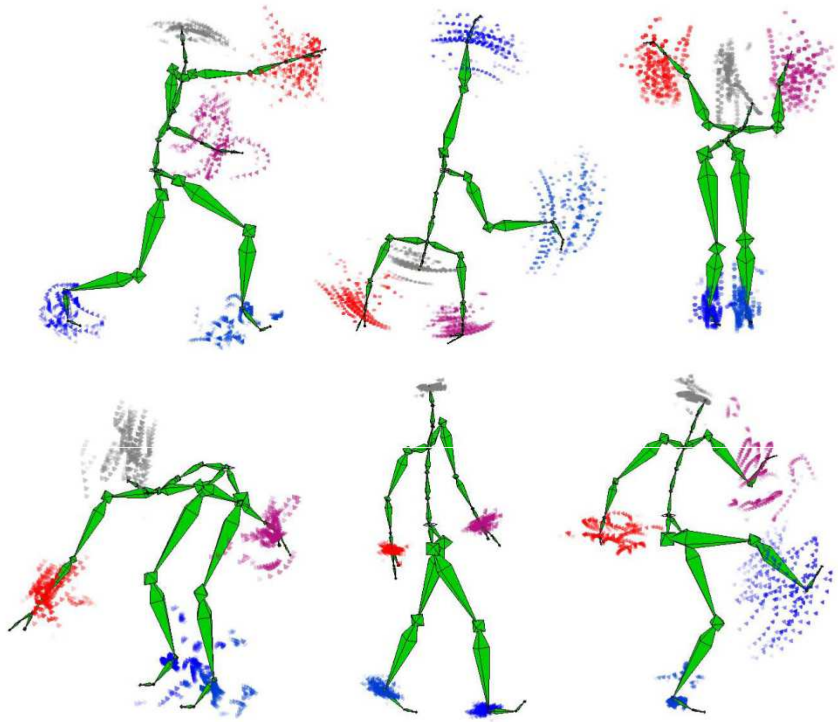
- Two problems
  - Searching for “neighboring motions”
    - For estimating Bayesian priors
  - Synthesizing motion that fit the control data
    - Vision data or sensor data

Motion Reconstruction From Few Sensors

- Searching in large collections of human motion data
  - For estimating Bayesian priors
- Using kd-trees search very efficient
  - Largest available collections about 1 million frames (at 30Hz)
  - On a natural 15-dimensional feature set
    - Positions of end-effectors of human skeleton
  - Still very efficient on 40-60 dimensional feature sets
    - Using windows of frames
    - Or acceleration features
  - On these not so large data collections curse of dimensionality not as bad as worst case considerations would predict

Motion Reconstruction From Few Sensors

- Examples of neighbors of motions
  - Found in a few milliseconds on 750min of Mocap data
    - CMU and HDM data bases
  - Positions of hands and feet and head visualzed
    - Fading out with increasing distance



Motion Reconstruction From Few Sensors

- Fast searches used for
  - Reconstruction of Motions Using Few Markers
    - On synthetic data
  - Fast global motion matching
  - Motion Synthesis
    - „Fat Graphs“
- Will be central technique for motion reconstruction from few inertial sensors
- Also a potential substitute for „motion stabilization“
  - Substitute of motion template based technique
    - Recent publication by groups of B. Rosenhahn and M. Müller
  - Easier and also faster (?)