CT2 Hair: High-Fidelity 3D Hair Modeling using Computed Tomography

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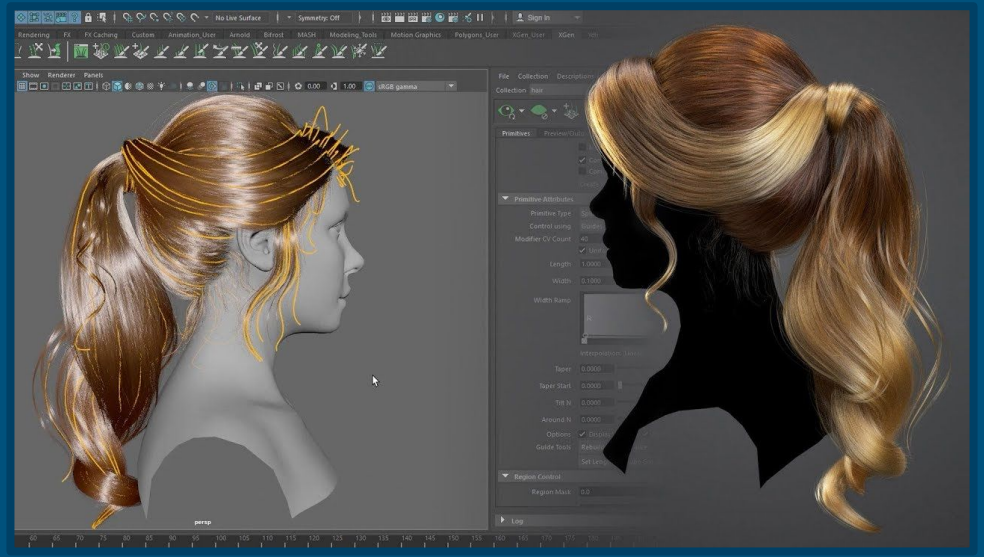
Introduction

- Why does realistic hair matter?
  - Essential for digital humans in video games, social media, and animation
- Challenges
  - Large number of strands
  - Incredible diversity in hair styles and types

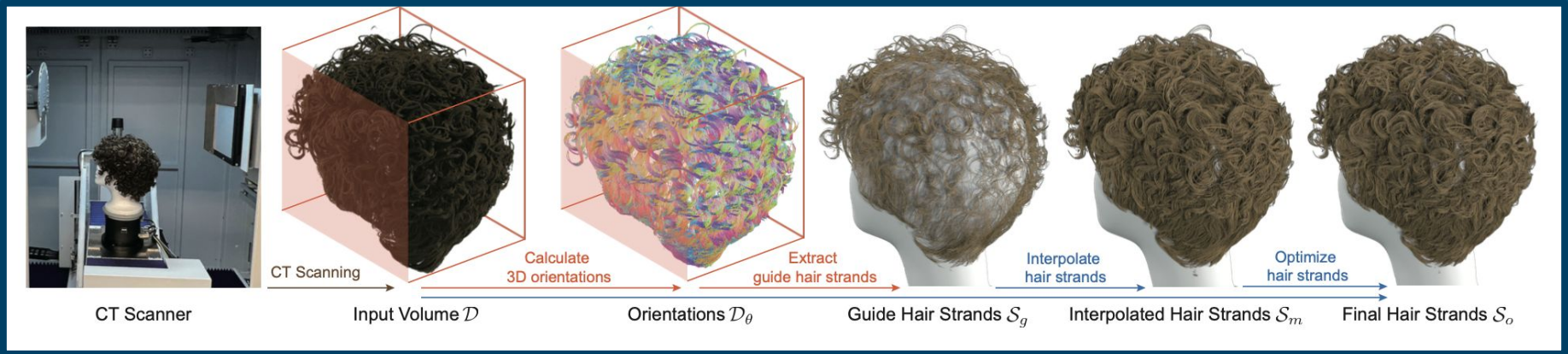
Traditional Methods

- Manual Creation
  - Time-consuming
  - Limited by tools
- Image-Based Methods
  - Limited by occlusion



CT2Hair Overview

- Method: Uses computed tomography (CT) for 3D hair modeling
- Coarse-to-Fine Approach
  - Guide strands creation
  - Interpolation for dense strands
  - Optimization for realism
- Significance: Overcomes occlusion to visualize the entire hair structure

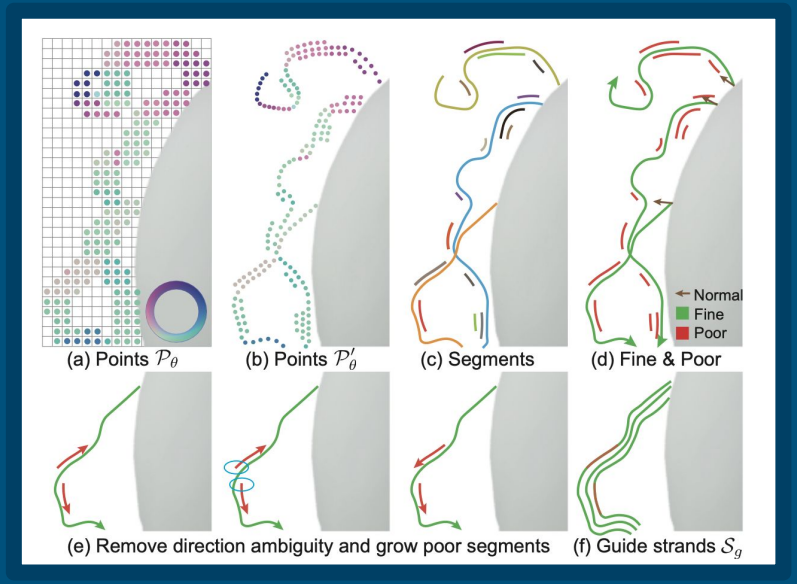


CT Scanning & Preprocessing

- CT Scanning
  - Produces 3D density volumes of hair regions
  - Resolution depends on scanner hardware and wig size
  - Initial Challenges
    - Noise and blurriness due to Modulation Transfer Function (MTF)
    - Low contrast between hair and air
- Preprocessing
  - Threshold filtering to remove irrelevant data (eg. air, mannequin head, etc.)
  - Remove hair net
    - Segment strand roots, reconstruct scalp, delete voxels near hair net

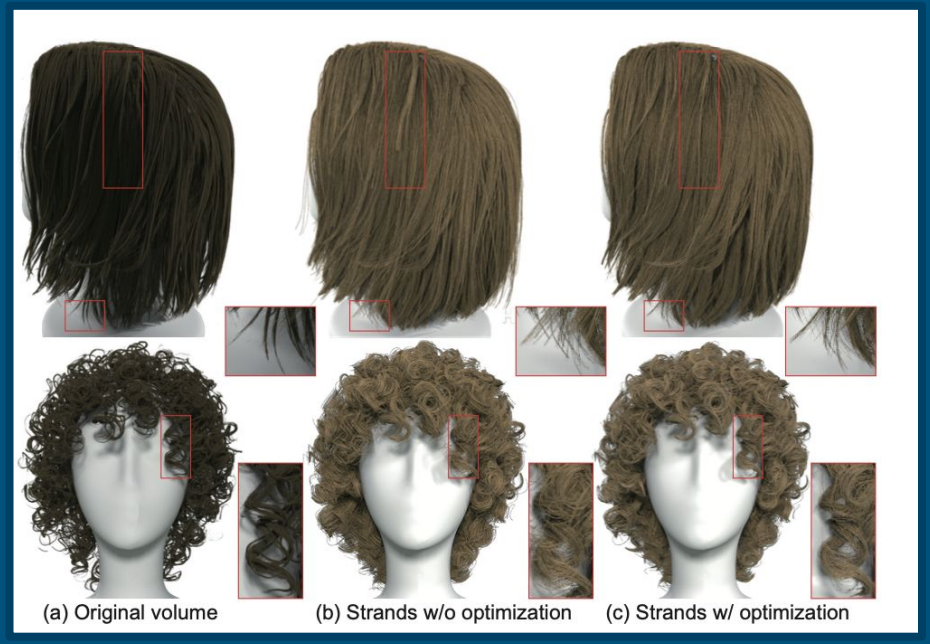
From 3D Volume to Guide Strands

- Steps to Create Guide Strands
  - Generate dense point cloud from 3D orientation volumes
  - Filter noise using mean-shift point cloud filtering
  - Connect and extend short hair segments into strands
  - Cluster hair segments into fine strands and poor segments
  - Redirect and grow poor segments alongside fine strands
  - Merge both sets to form guide hair strands



Dense Strand Optimization

- Interpolation
  - Uses neural interpolation to uniformly distribute guide strands across the scalp
- Optimization
  - Aligns dense strands with CT density volumes for accuracy
  - Refines strand structure to create natural wisps and realistic appearance



Results & Applications

- Results
  - First recovery of occluded hair structures
  - Handles diverse hair types
  - Ready for downstream applications
  - Limitations
    - Unsuitable for live humans due to high radiation levels
- Applications
  - Digital Animation
  - Physically-based simulations
  - Game design and rendering

Conclusion

- Introduces a scalable, accurate framework for 3D hair modeling
- Combines CT technology with innovative algorithms to overcome previous limitations
- Revolutionizes digital human representation