Hair Meshes

Cem Yuksel
Cyber Radiance

Scott Schaefer
Texas A&M University

John Keyser
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Lee Perry-Smith, www.ir-models.com

Lee Perry-Smith, www.ir-models.com

Lee Perry-Smith, www.ir-models.com

Cédric Lepiller, http://www.pitiwazou.com

Luc Begin, bigguns.cgsociety.org - Model by Cedric Lepiller, www.pitiwazou.com

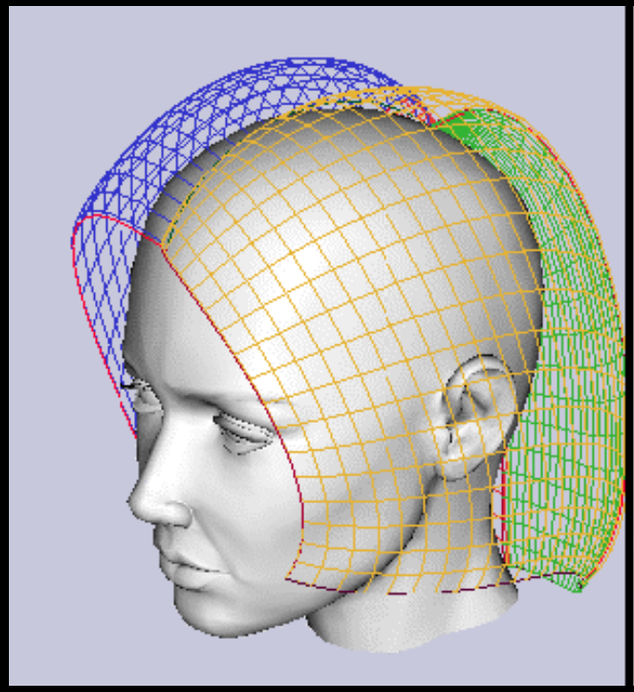
Alexander Tomchuk, www.at.3dua.com

Hair Modeling

Previous Work

Previous Work on Hair Modeling

- Flat surfaces



Kim and Neumann 2000

Koh and Huang 2001

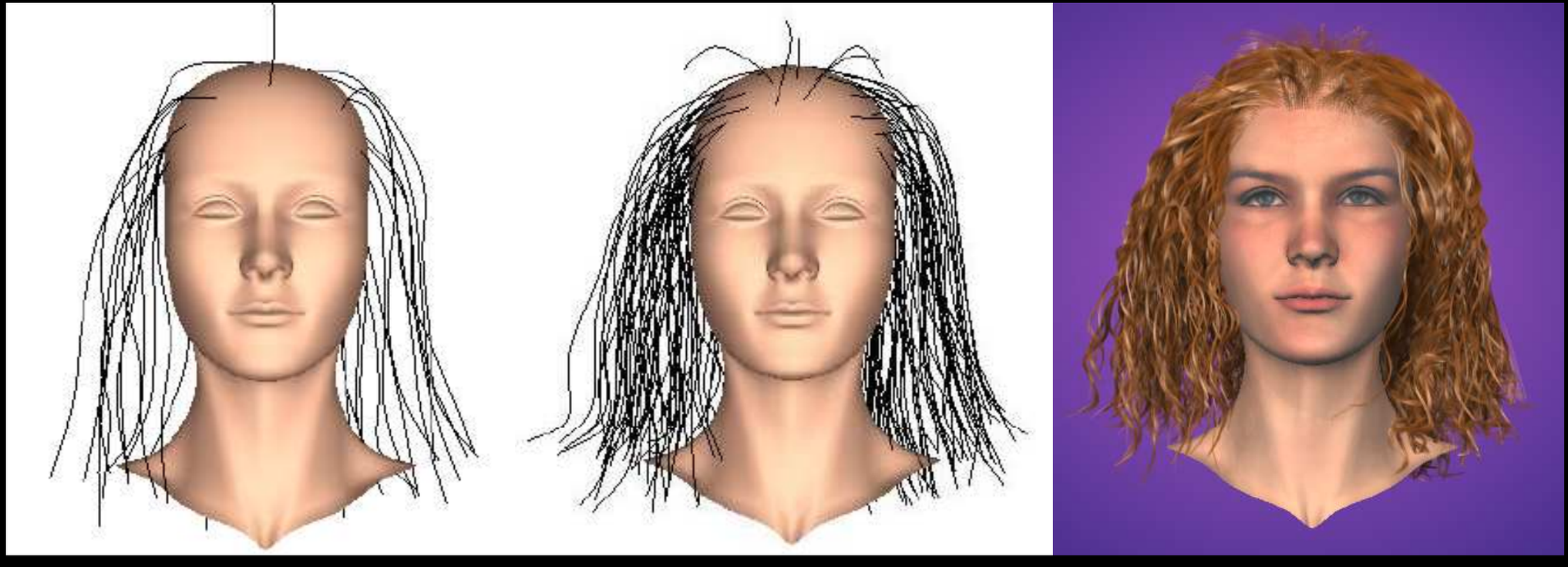
Previous Work on Hair Modeling

- Wisps and generalized cylinders

Yang et al. 2000

Previous Work on Hair Modeling

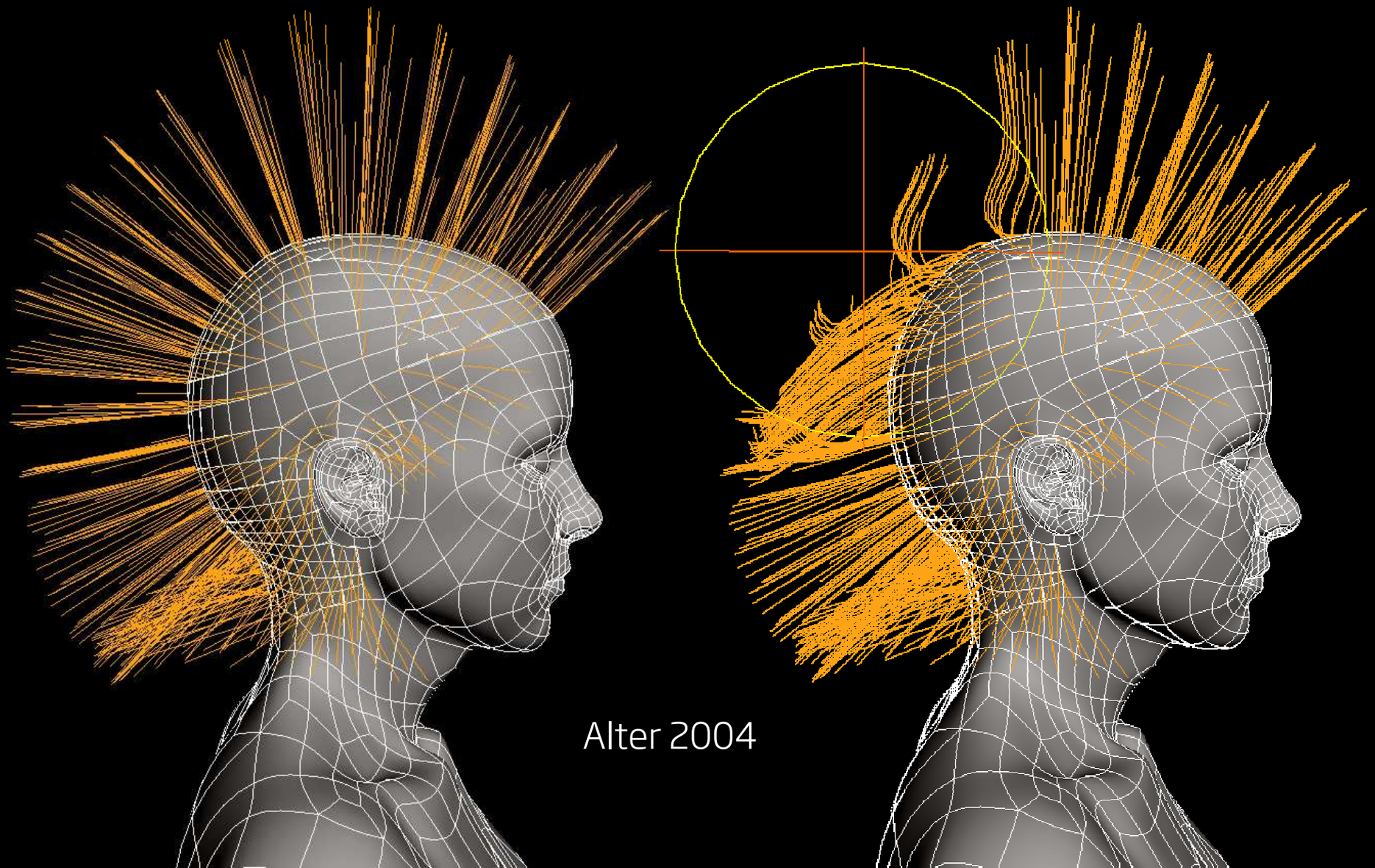
- Wisps and generalized cylinders



Kim and Neumann 2002

Previous Work on Hair Modeling

- Guide curves



Alter 2004

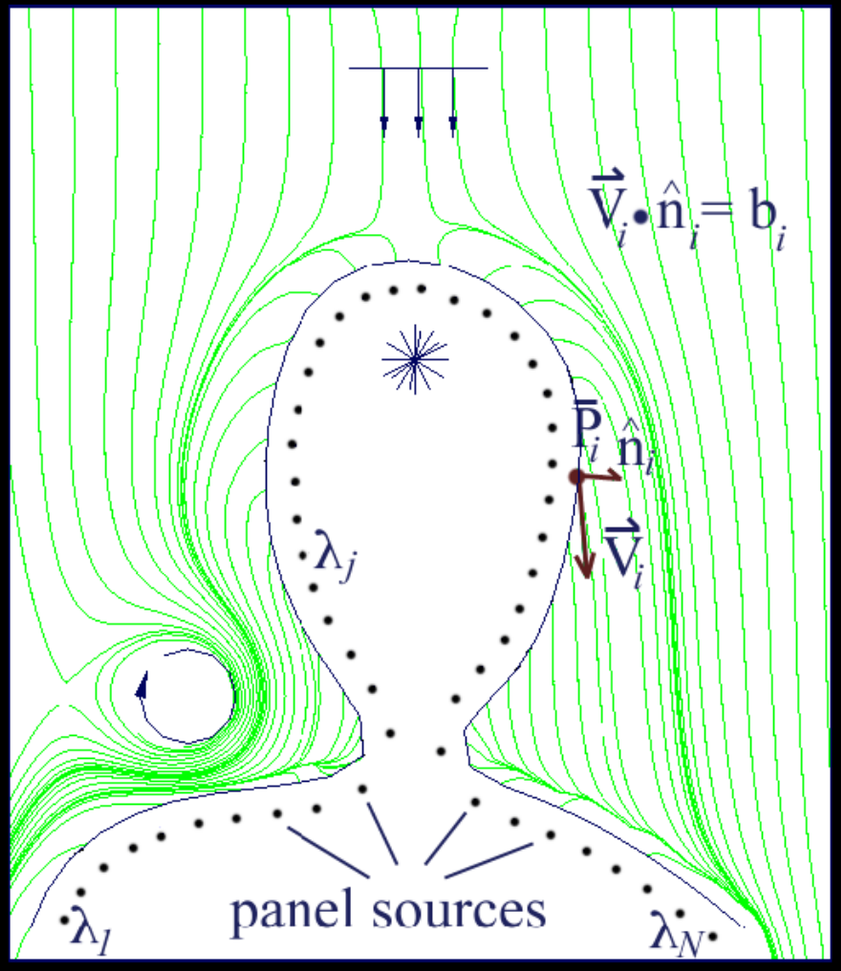
Previous Work on Hair Modeling

- Physically-based approaches

Anjyo et al. 1992

Previous Work on Hair Modeling

- Physically-based approaches



Hadap and Magnenat-Thalmann 2000

Previous Work on Hair Modeling

- Physically-based approaches

Yu 2001

Previous Work on Hair Modeling

- Physically-based approaches

Choe and Ko 2005

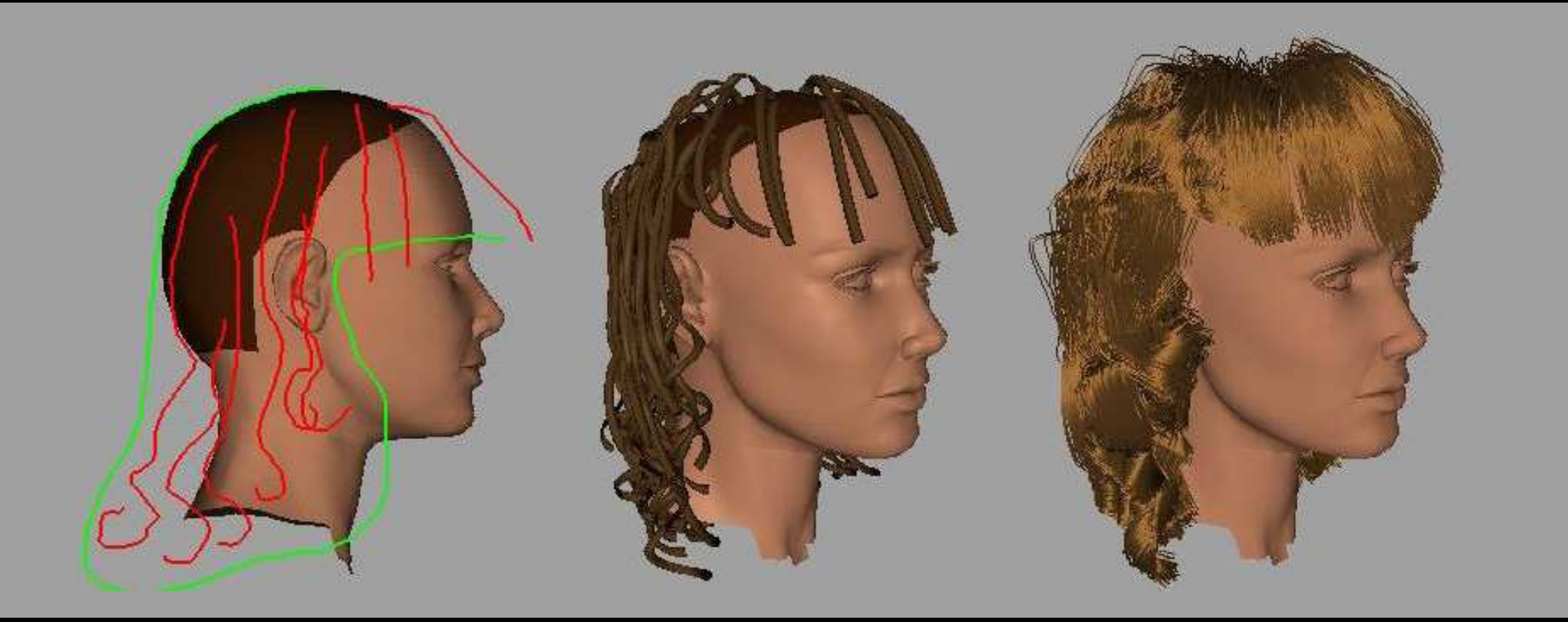
Previous Work on Hair Modeling

- Physically-based approaches

Ward et al. 2007

Previous Work on Hair Modeling

- Sketch-based interfaces



Wither et al. 2007

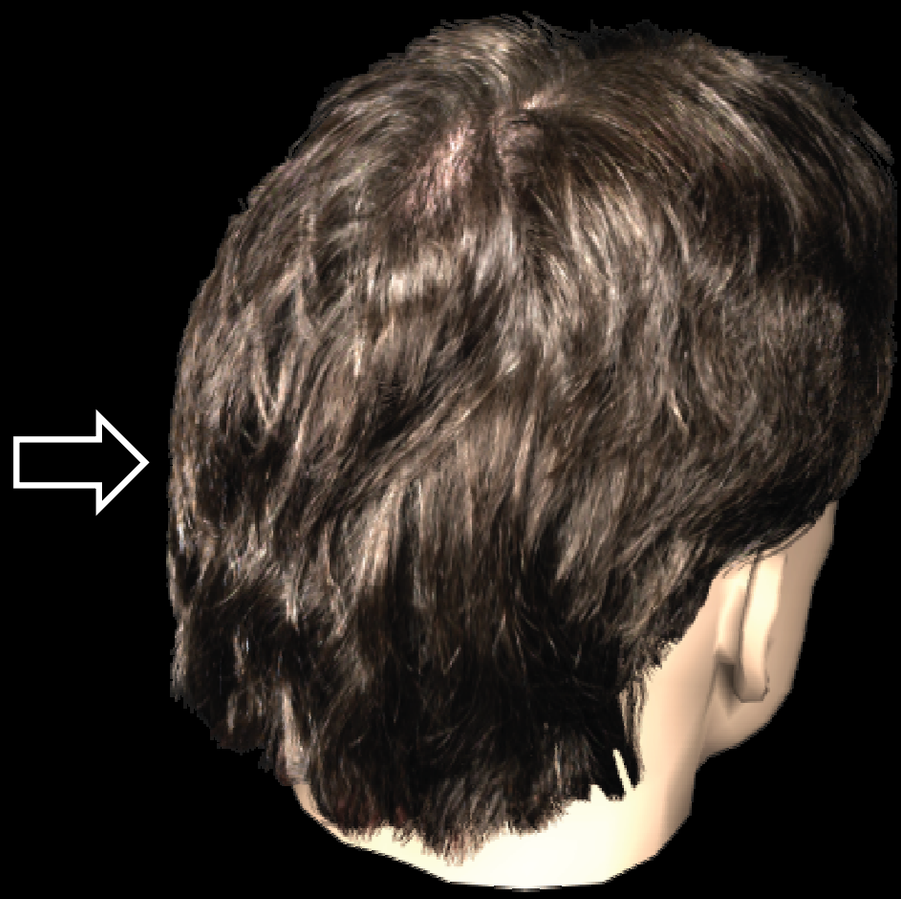
Previous Work on Hair Modeling

- Sketch-based interfaces

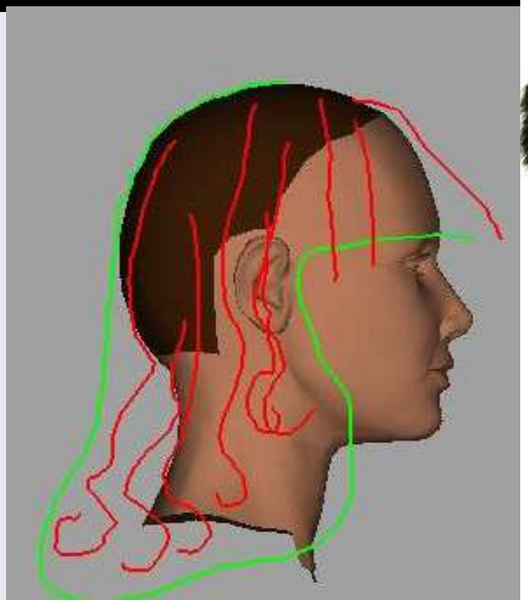
Fu et al. 2007

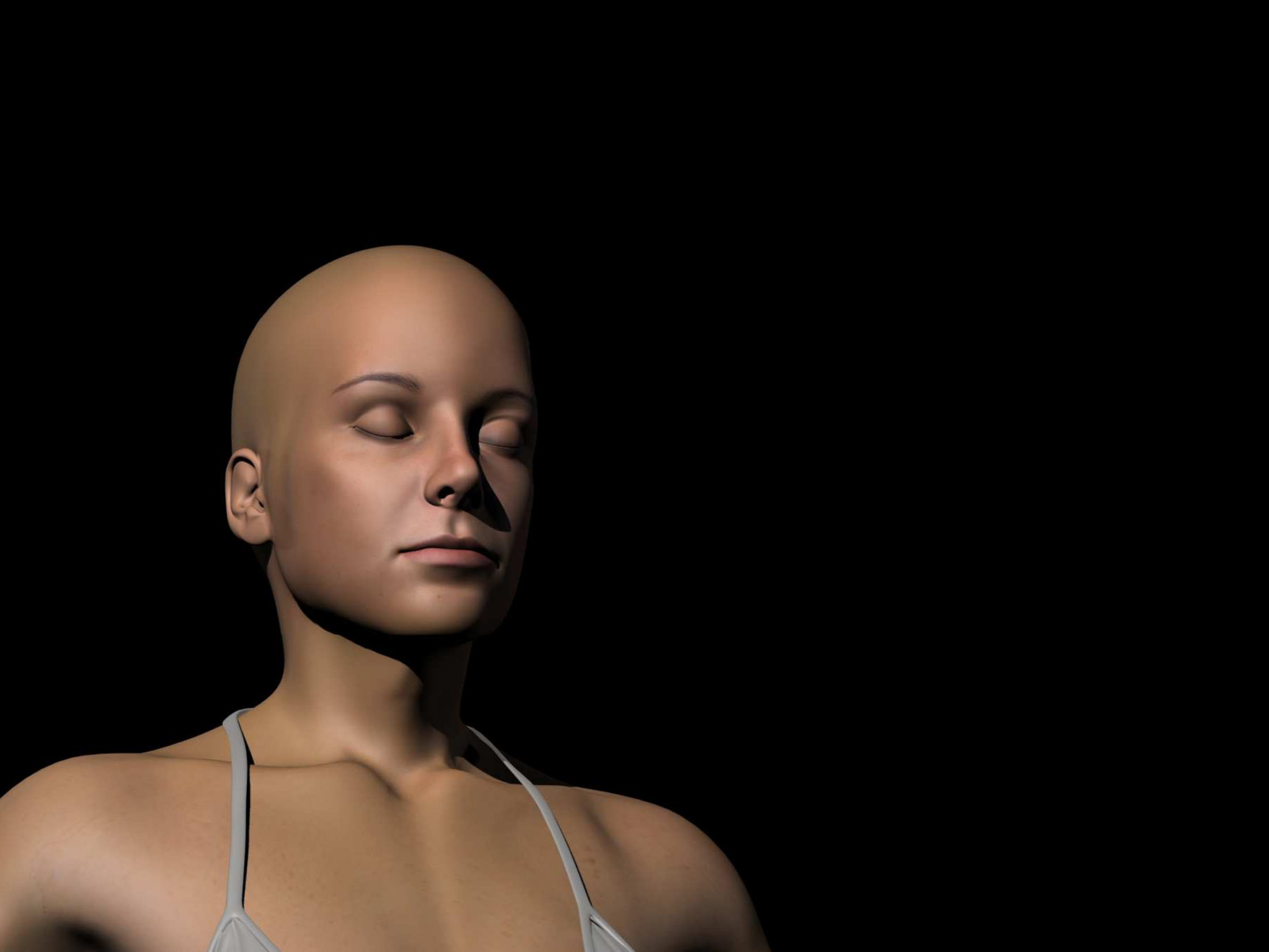
Previous Work on Hair Modeling

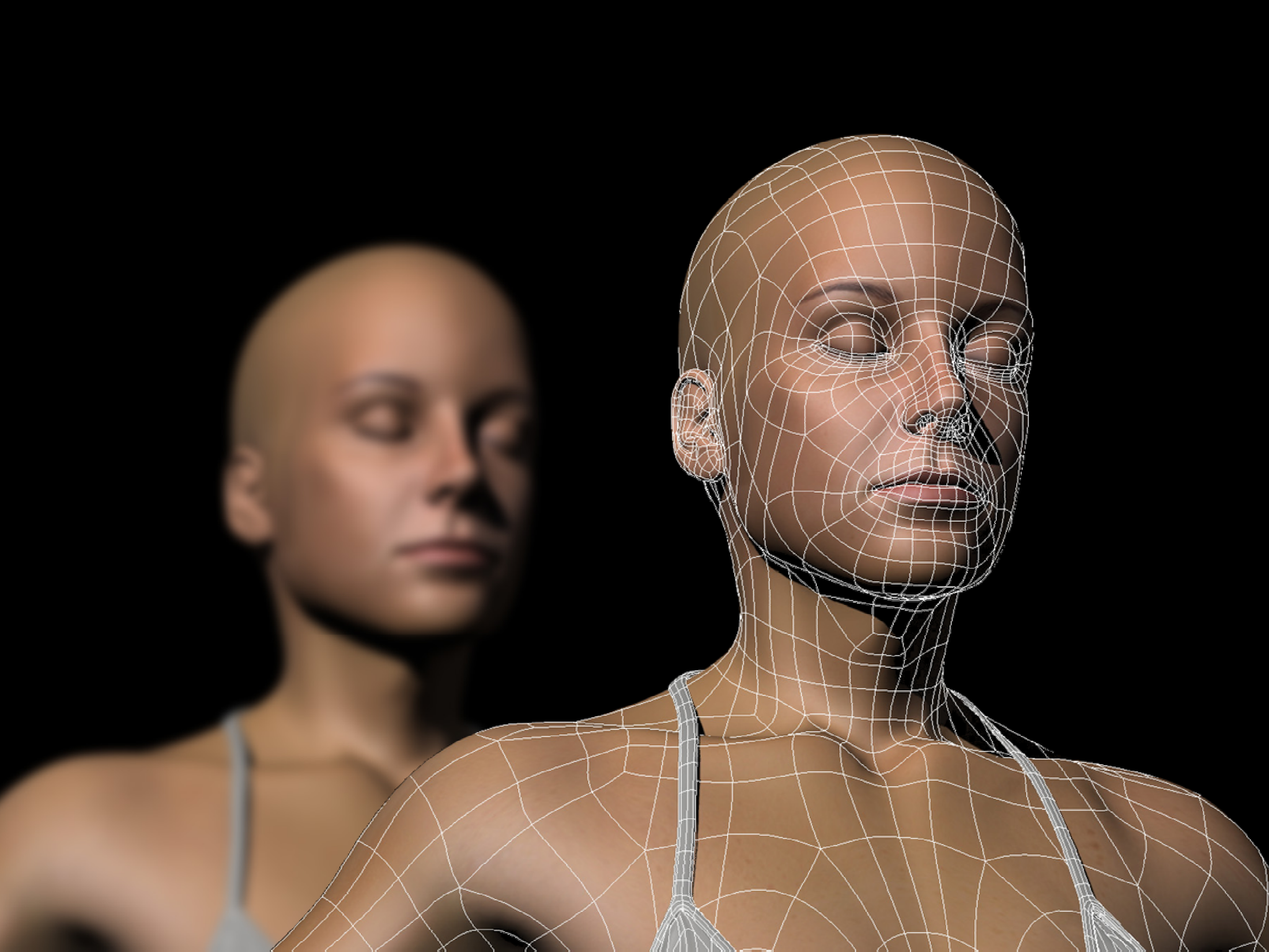
- Hair Capturing



Paris et al. 2008







Hair Modeling

- Question: Why not use polygons?
  - Polygons are widely accepted
  - Artists are already familiar with polygons
- Unfortunately,
  - Polygons represent surfaces
  - Hair is volumetric
- However,
  - We perceive hair as a surface

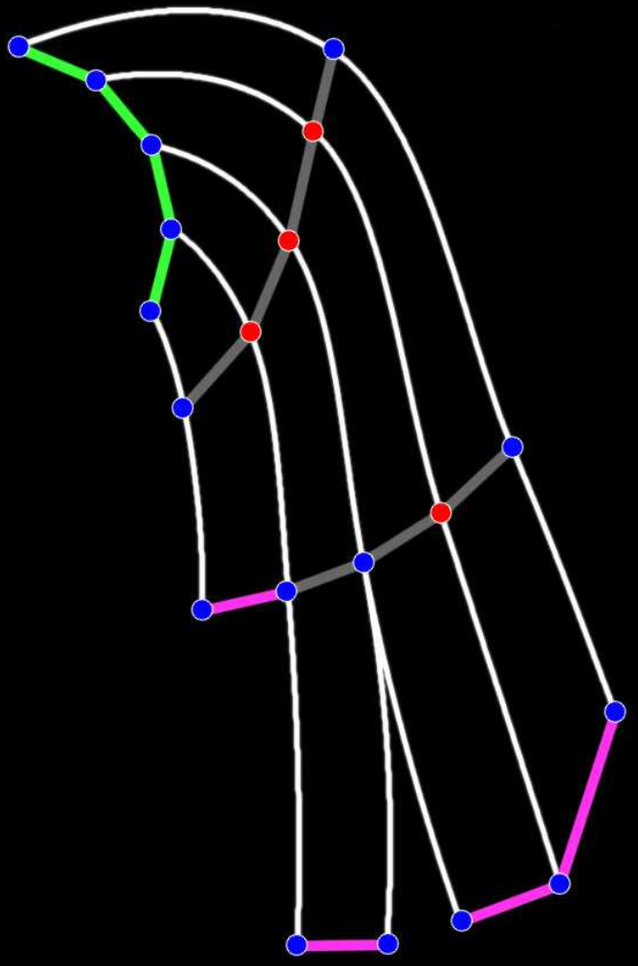
Hair Modeling with

Hair Meshes

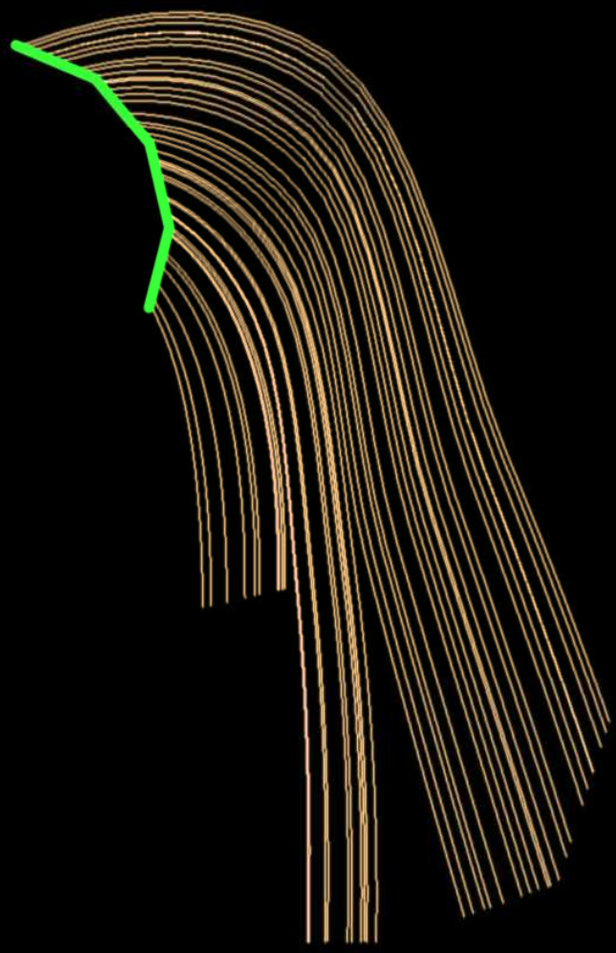
Hair Meshes

- Volumetric Structure
  - Topological connections
  - Can uniquely trace a path from root to tip
- Editable as a surface
  - Polygonal modeling concepts
  - Obey topological constraints

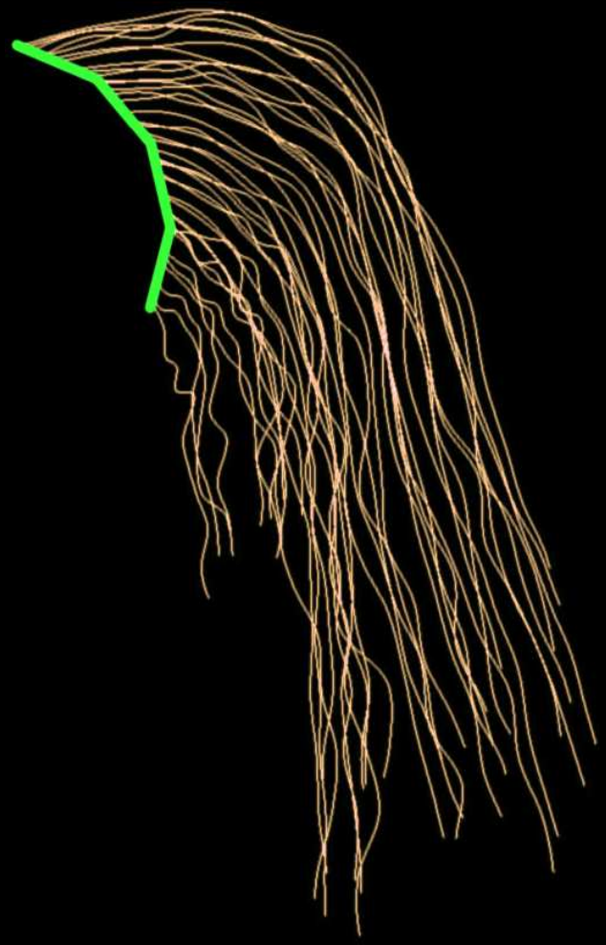
Hair Modeling with Hair Meshes



Hair Mesh Modeling

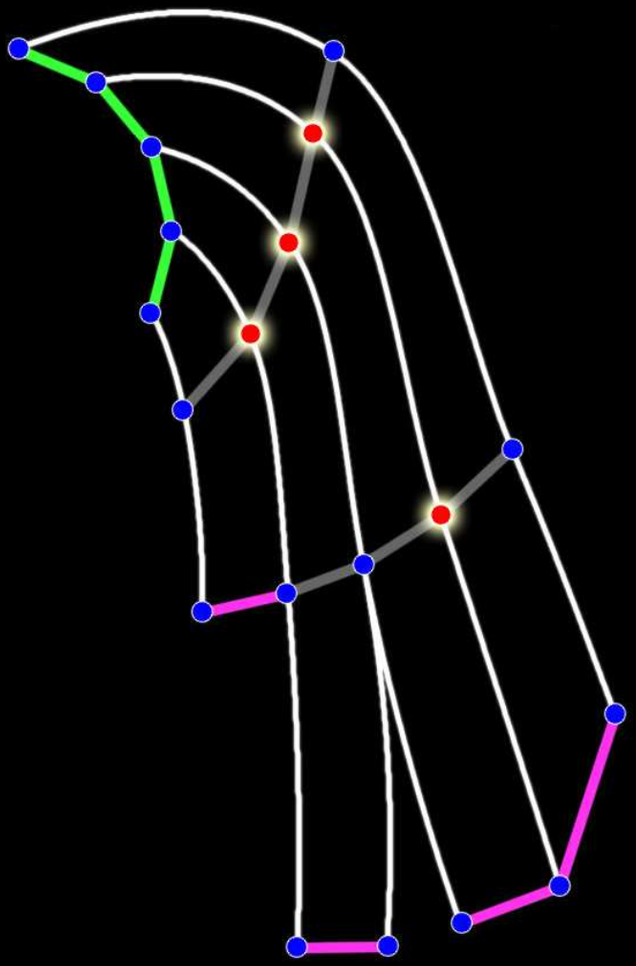


Hair Generation



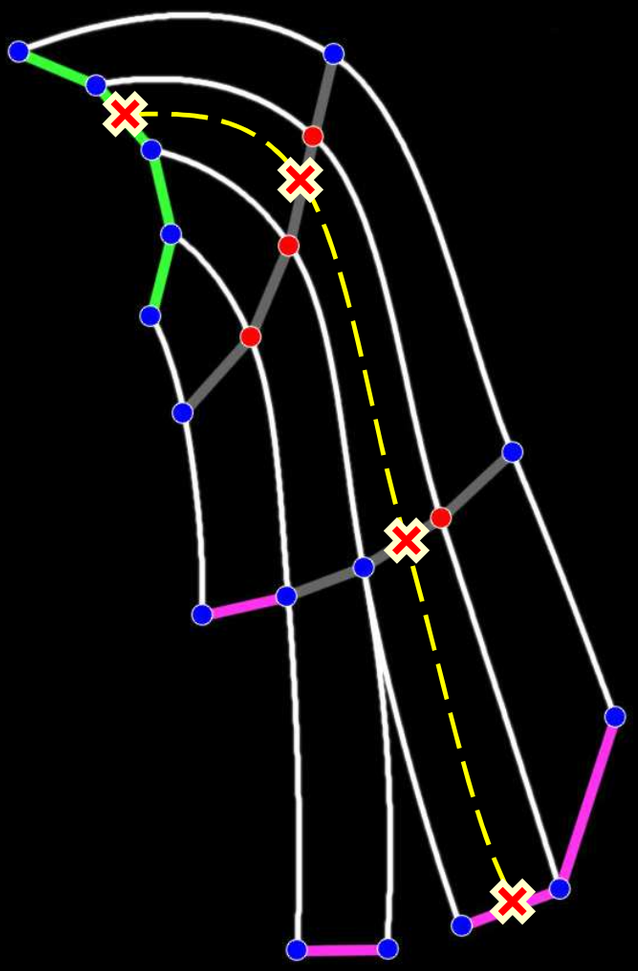
Hair Styling

Hair Meshes



- Layers
  - Root Layer
  - Tip Layer
- Vertices
  - External Vertices
  - Internal Vertices

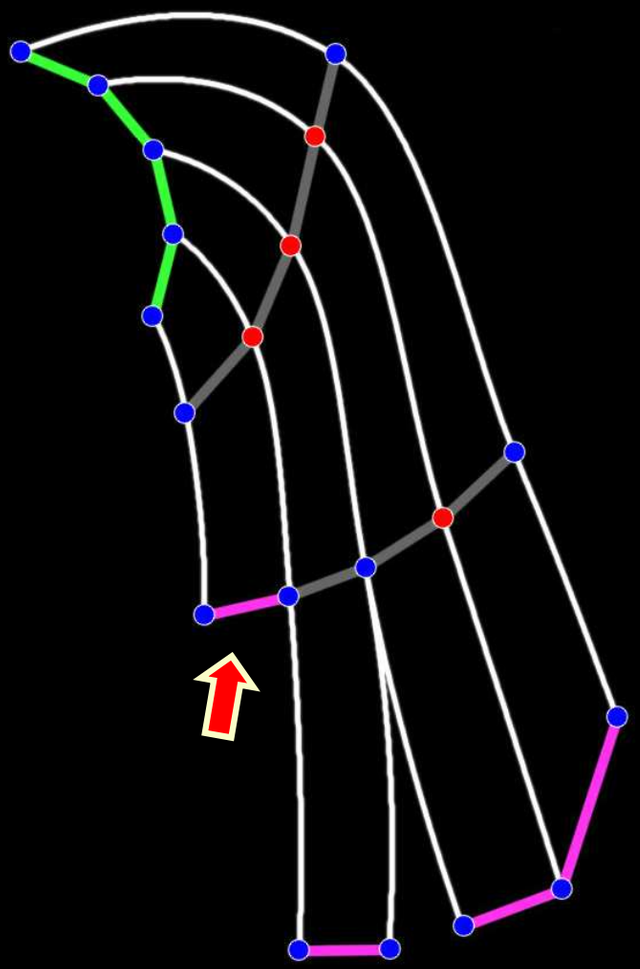
Hair Meshes



Hair Generation

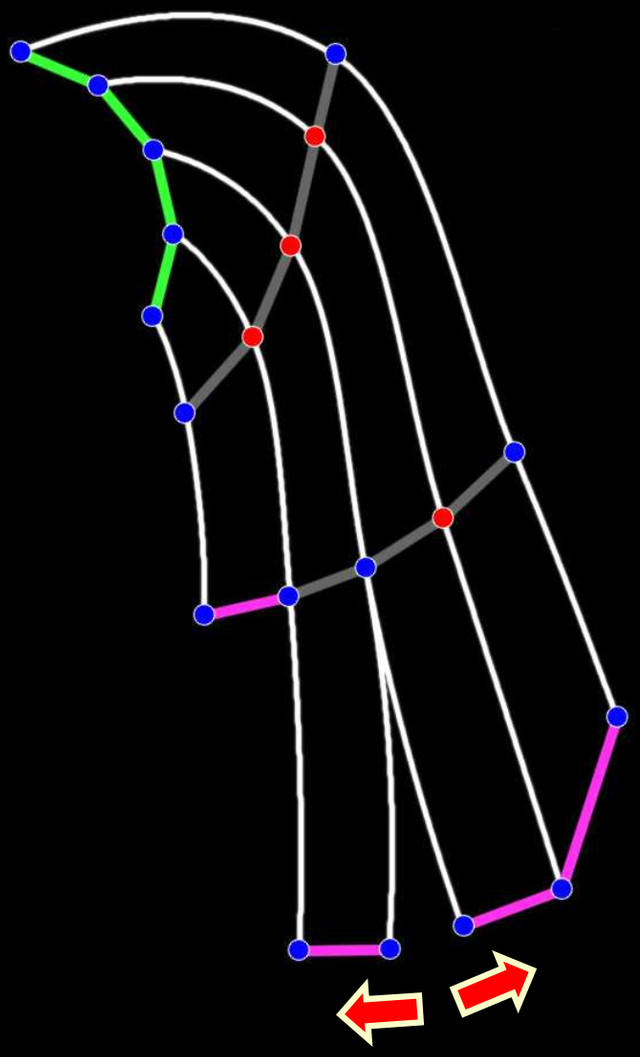
- Pick a point at root layer
- Find corresponding points on all layers
- Connect them with a curve (ex. Catmull-Rom splines)

Hair Meshes



- Tip layer can be different for each face

Hair Meshes



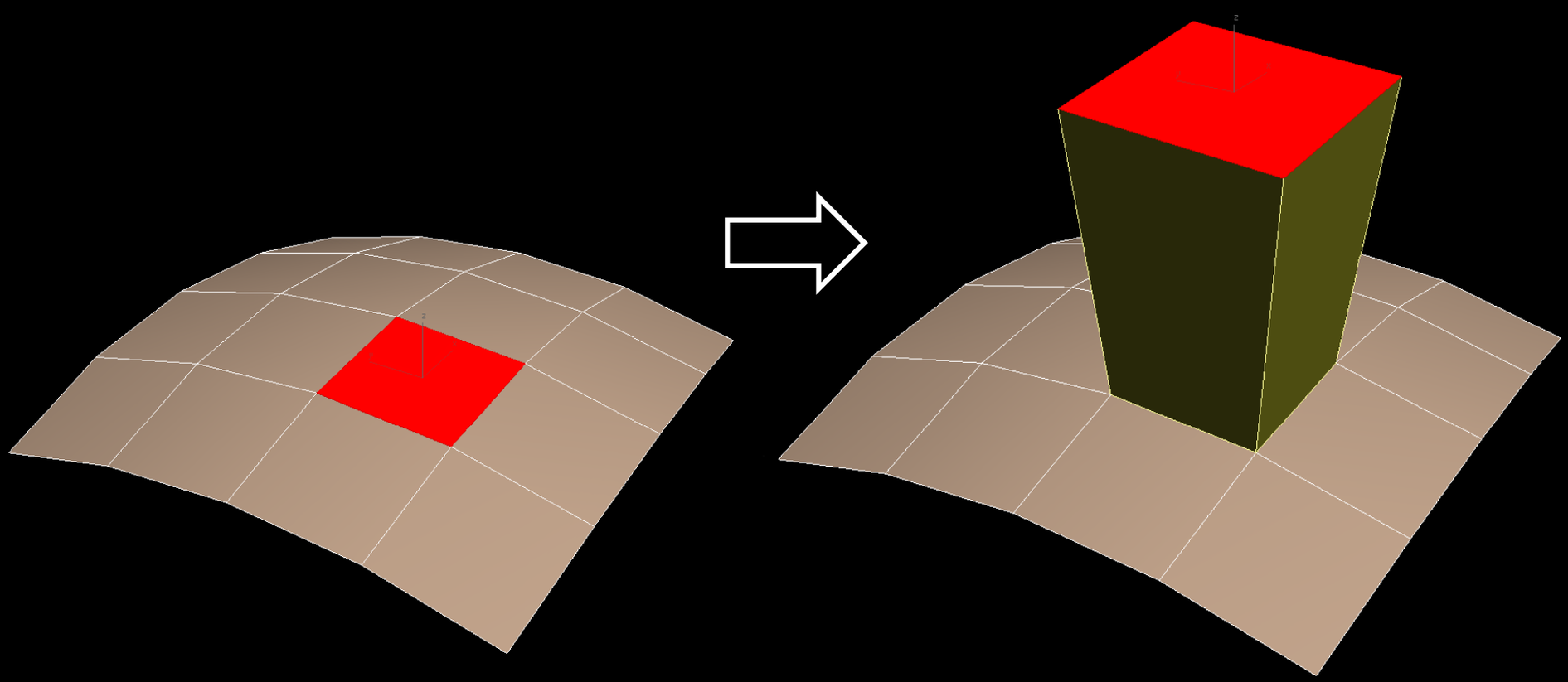
- Tip layer can be different for each face
- Topology can change between layers

Hair Mesh

Topological Operations

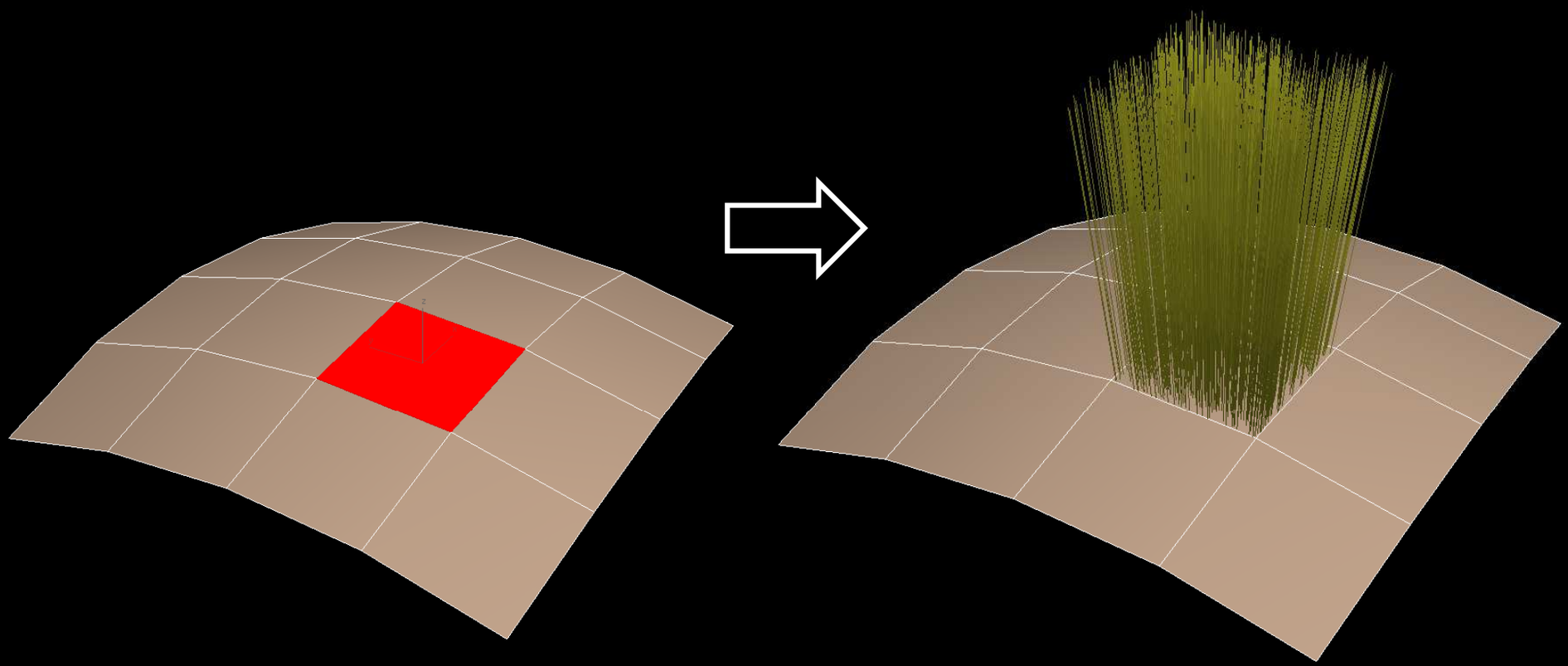
Topological Operations

- Face Extrude



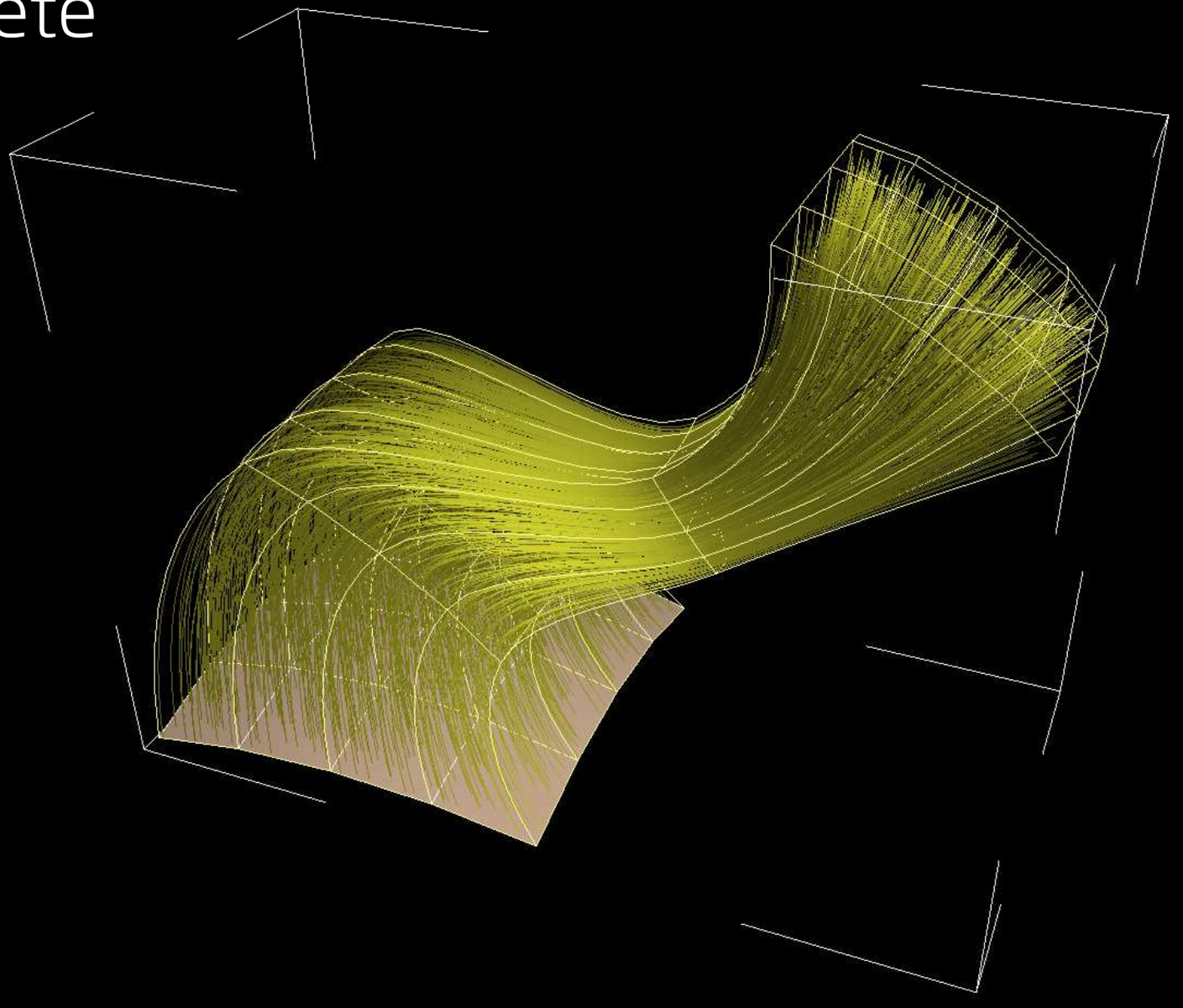
Topological Operations

- Face Extrude



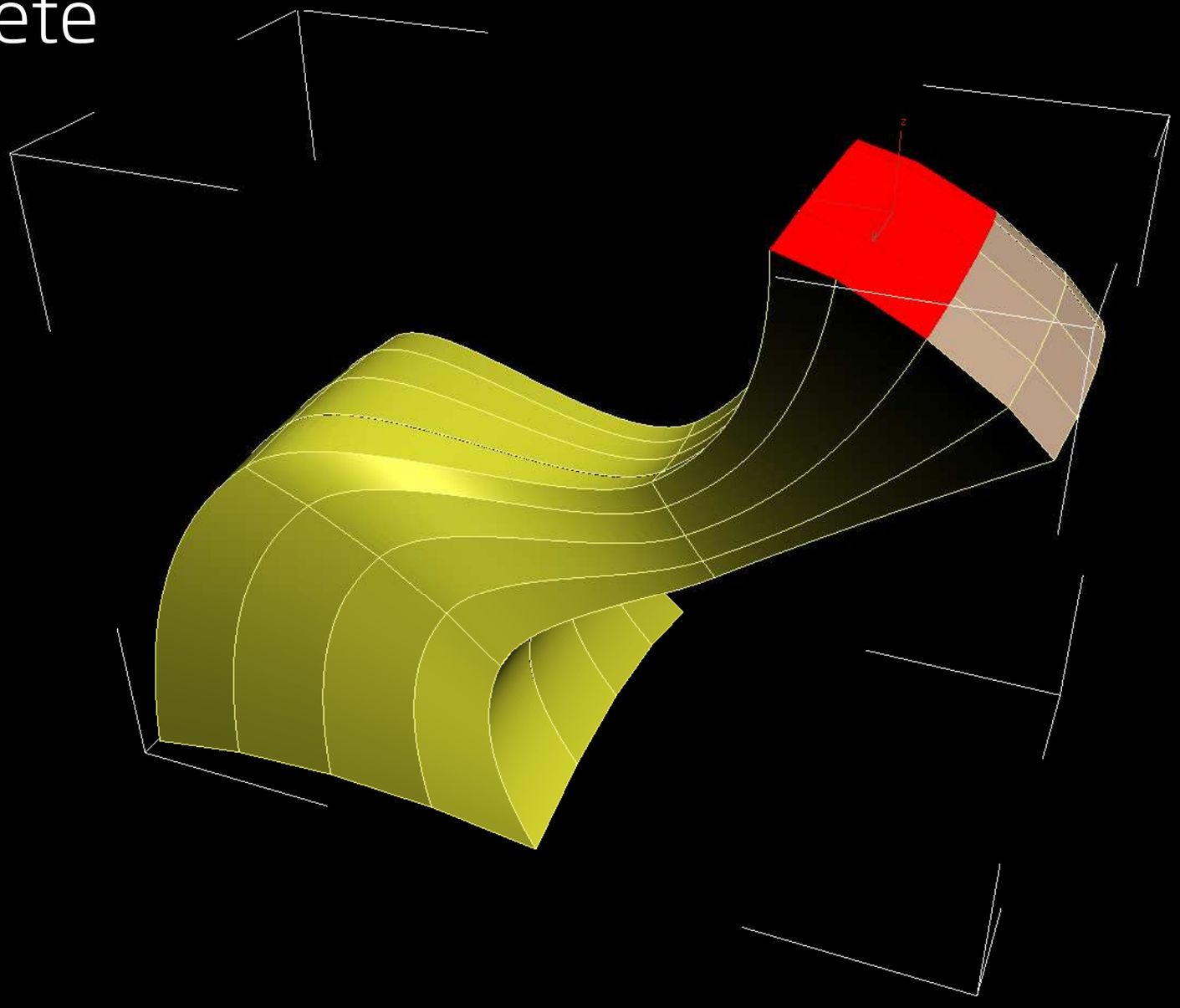
Topological Operations

- Face Delete



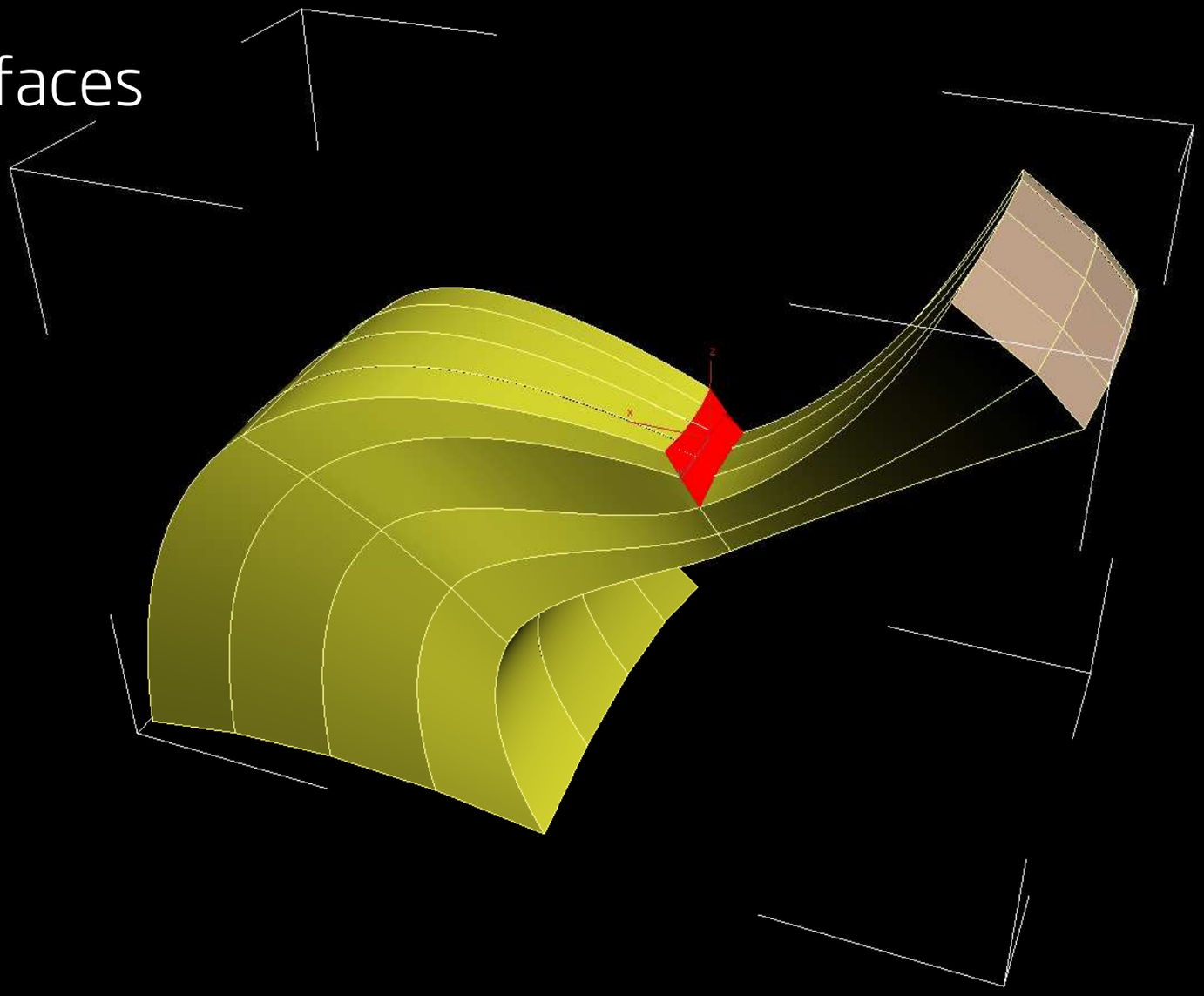
Topological Operations

- Face Delete



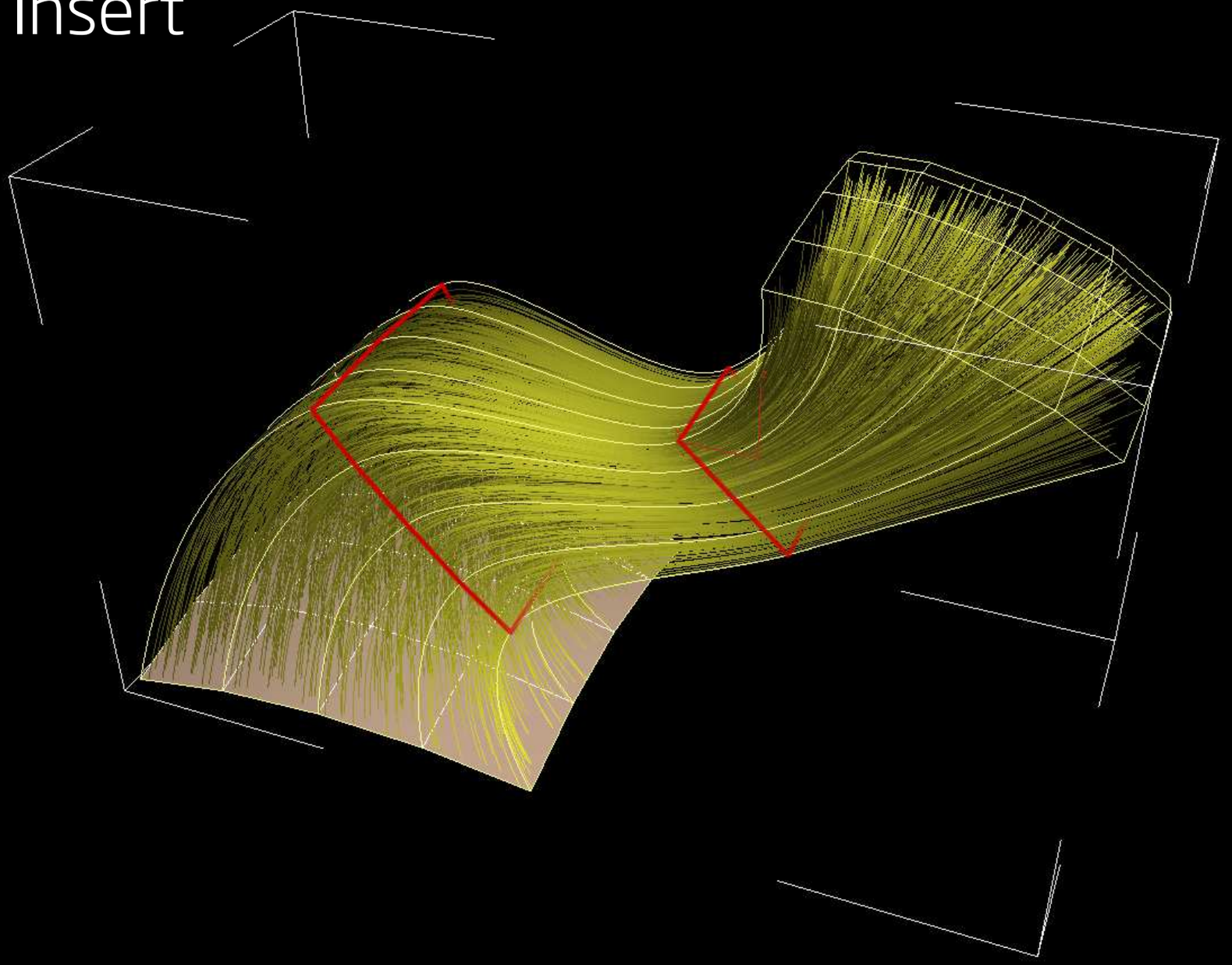
Topological Operations

- Face Delete
  - Only tip faces



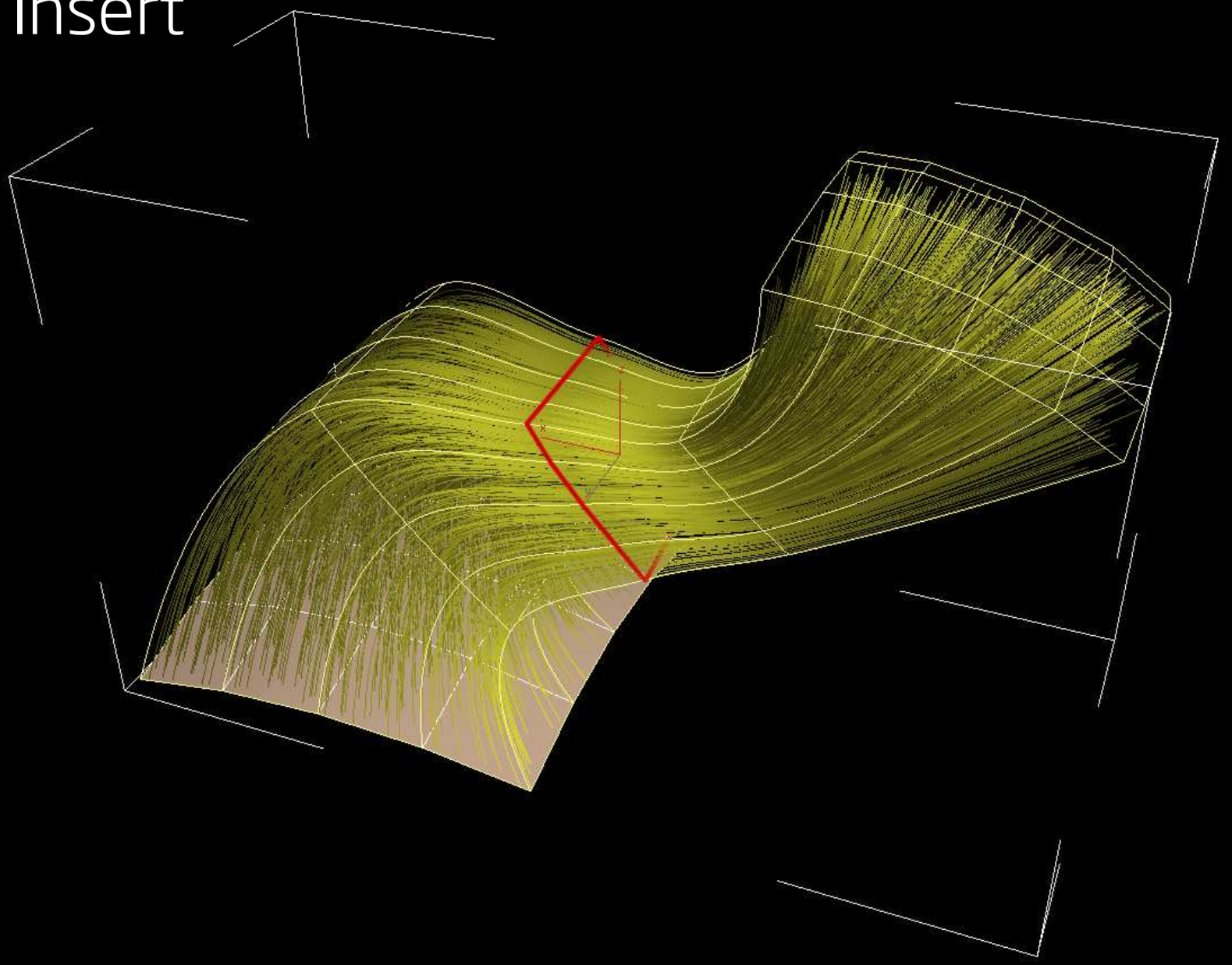
Topological Operations

- Layer Insert



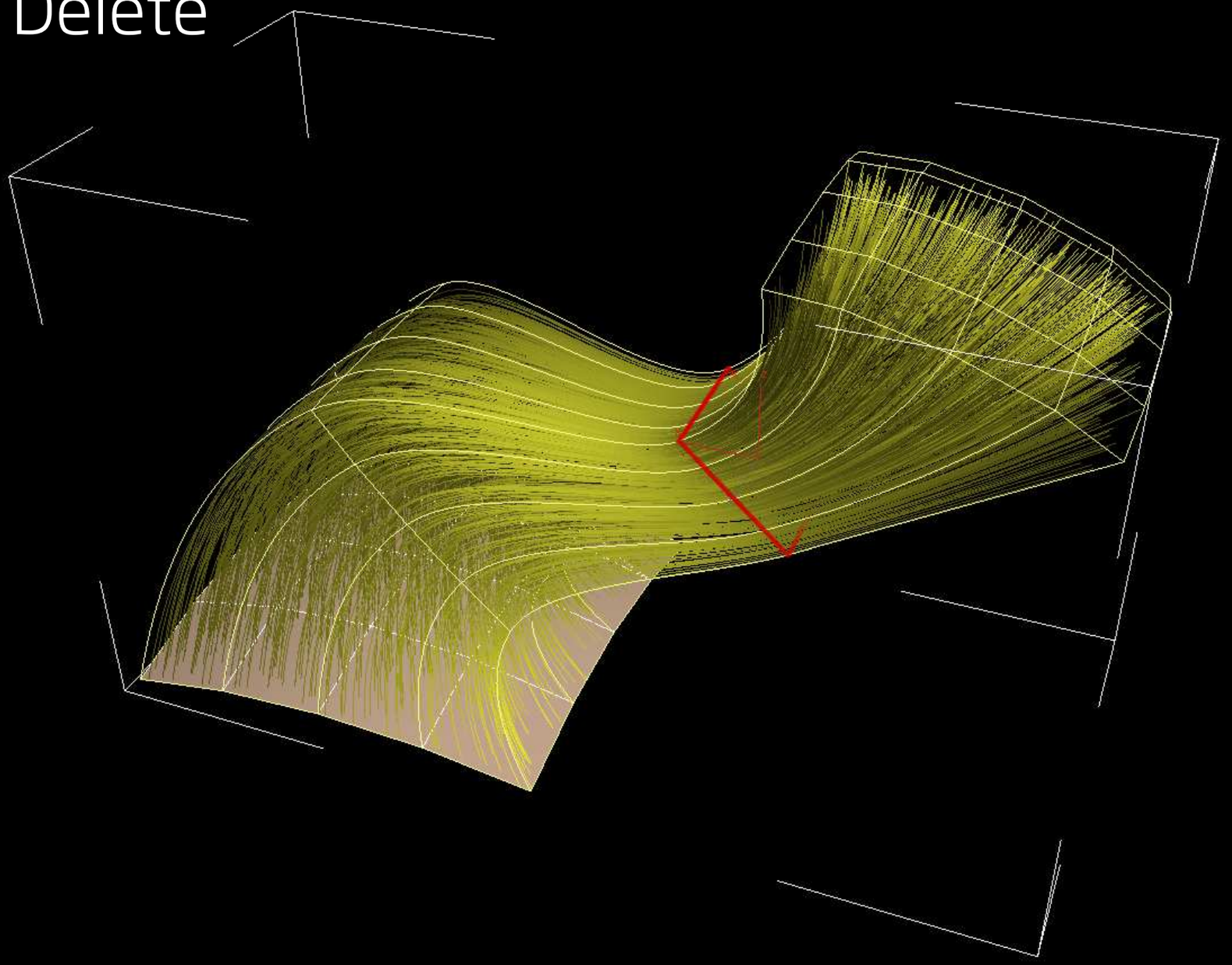
Topological Operations

- Layer Insert



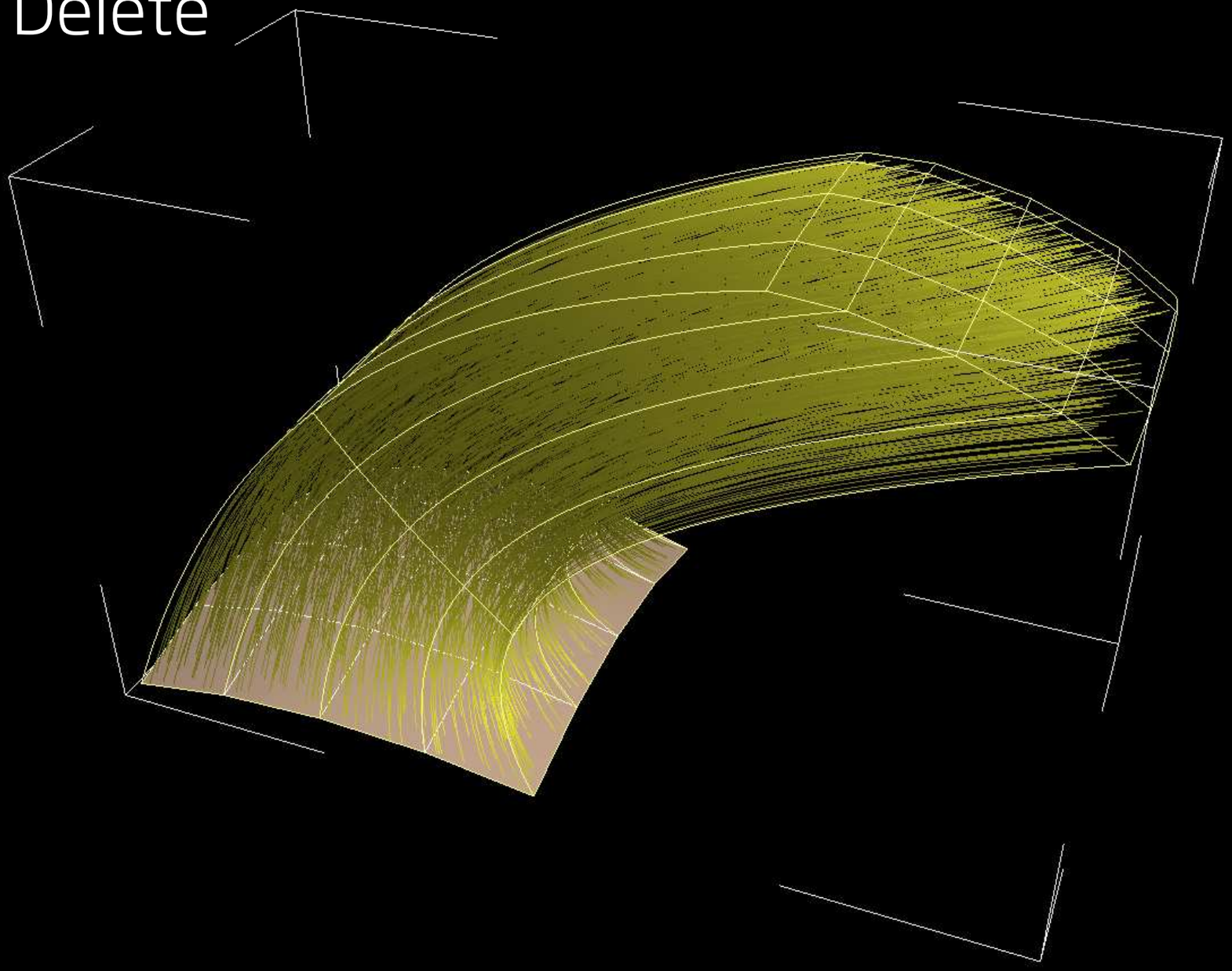
Topological Operations

- Layer Delete



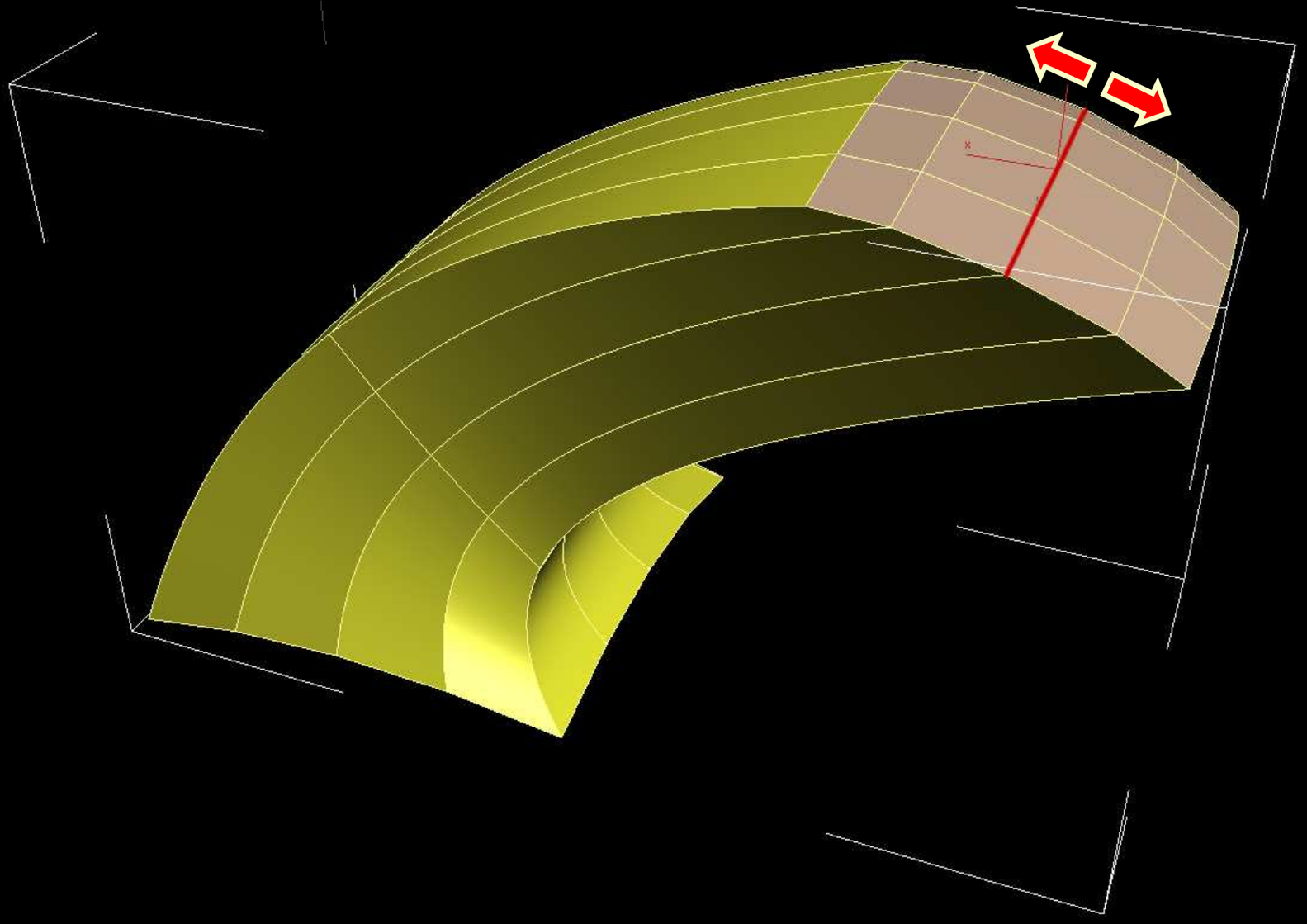
Topological Operations

- Layer Delete



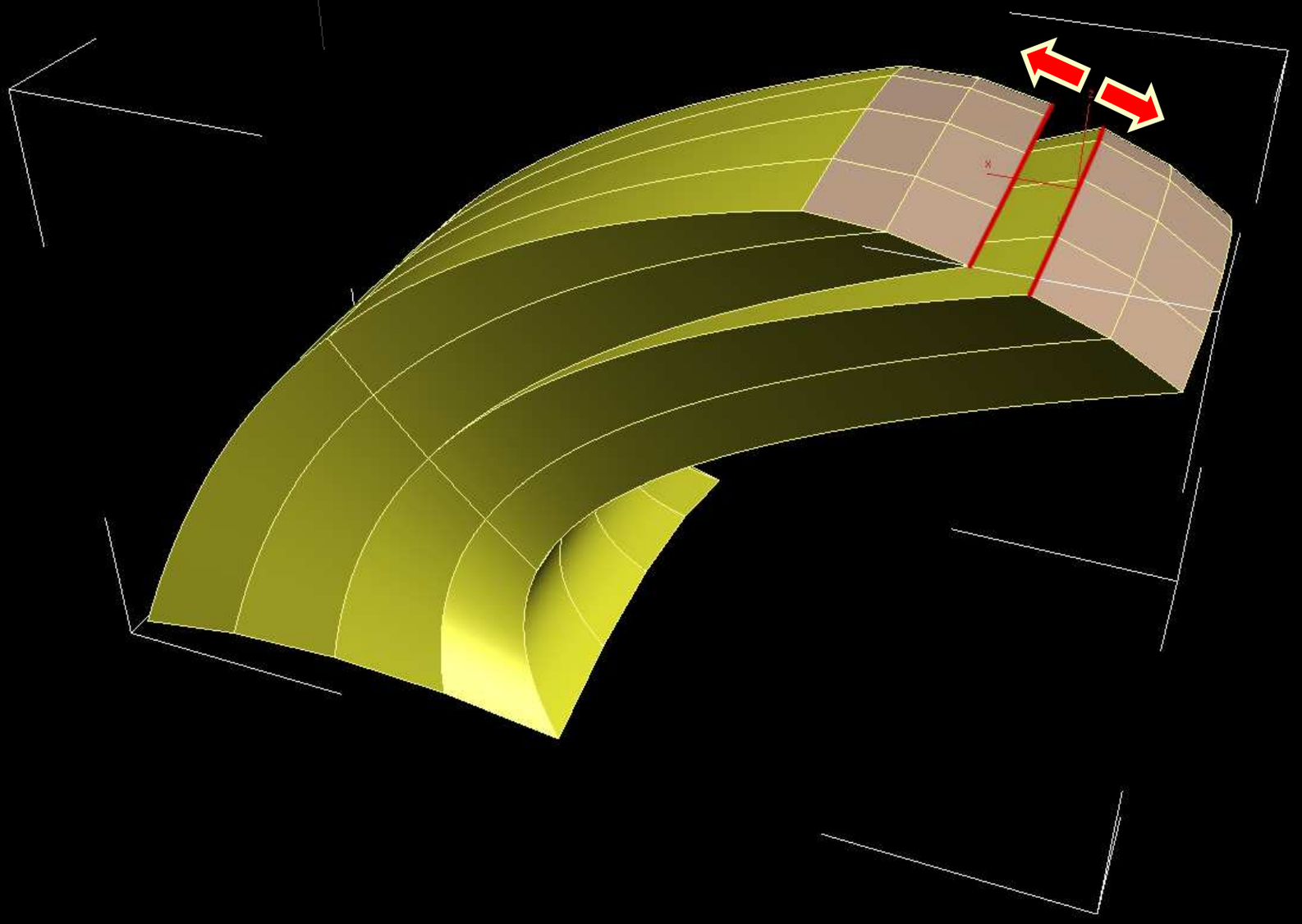
Topological Operations

- Edge/Vertex Separate



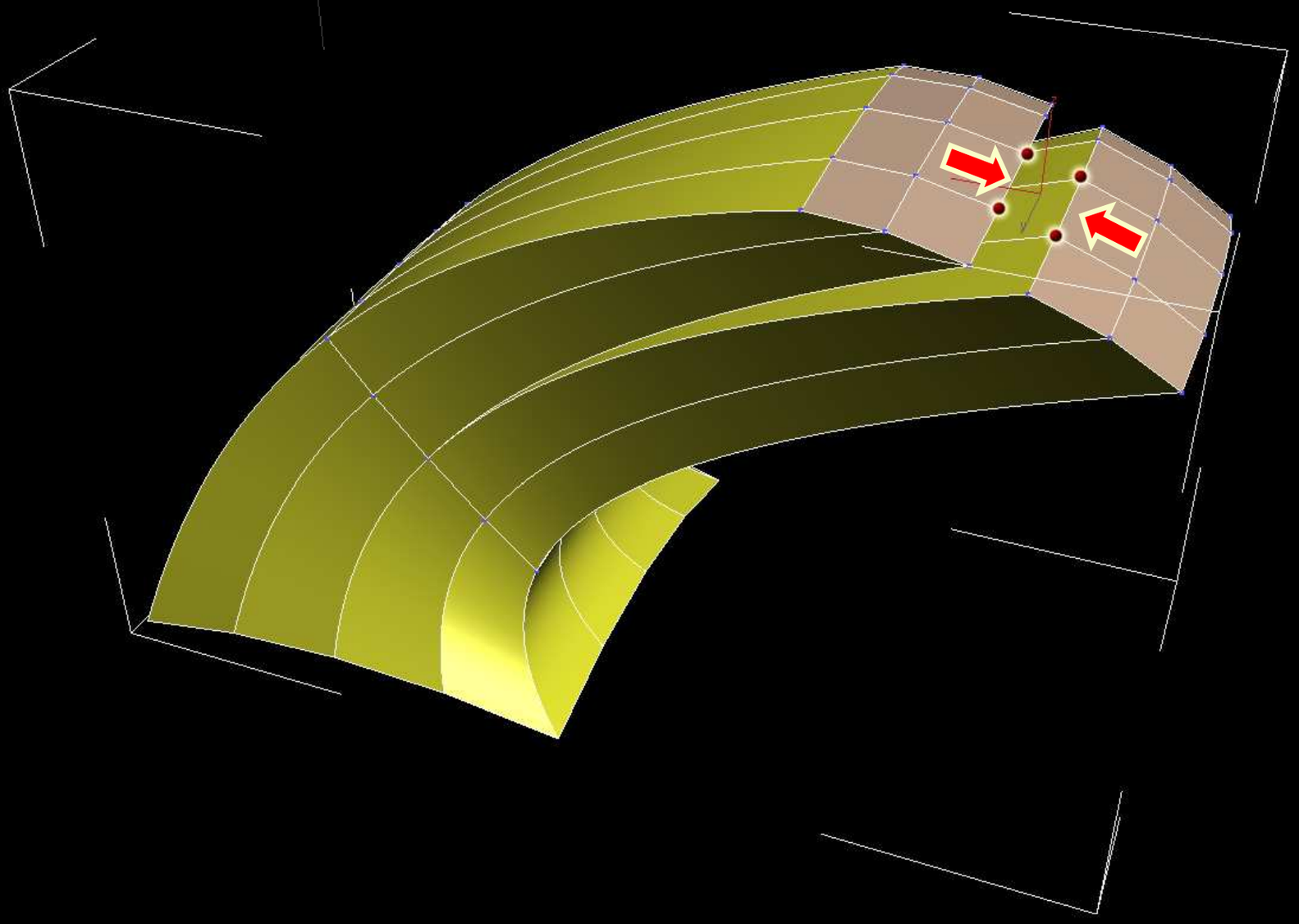
Topological Operations

- Edge/Vertex Separate



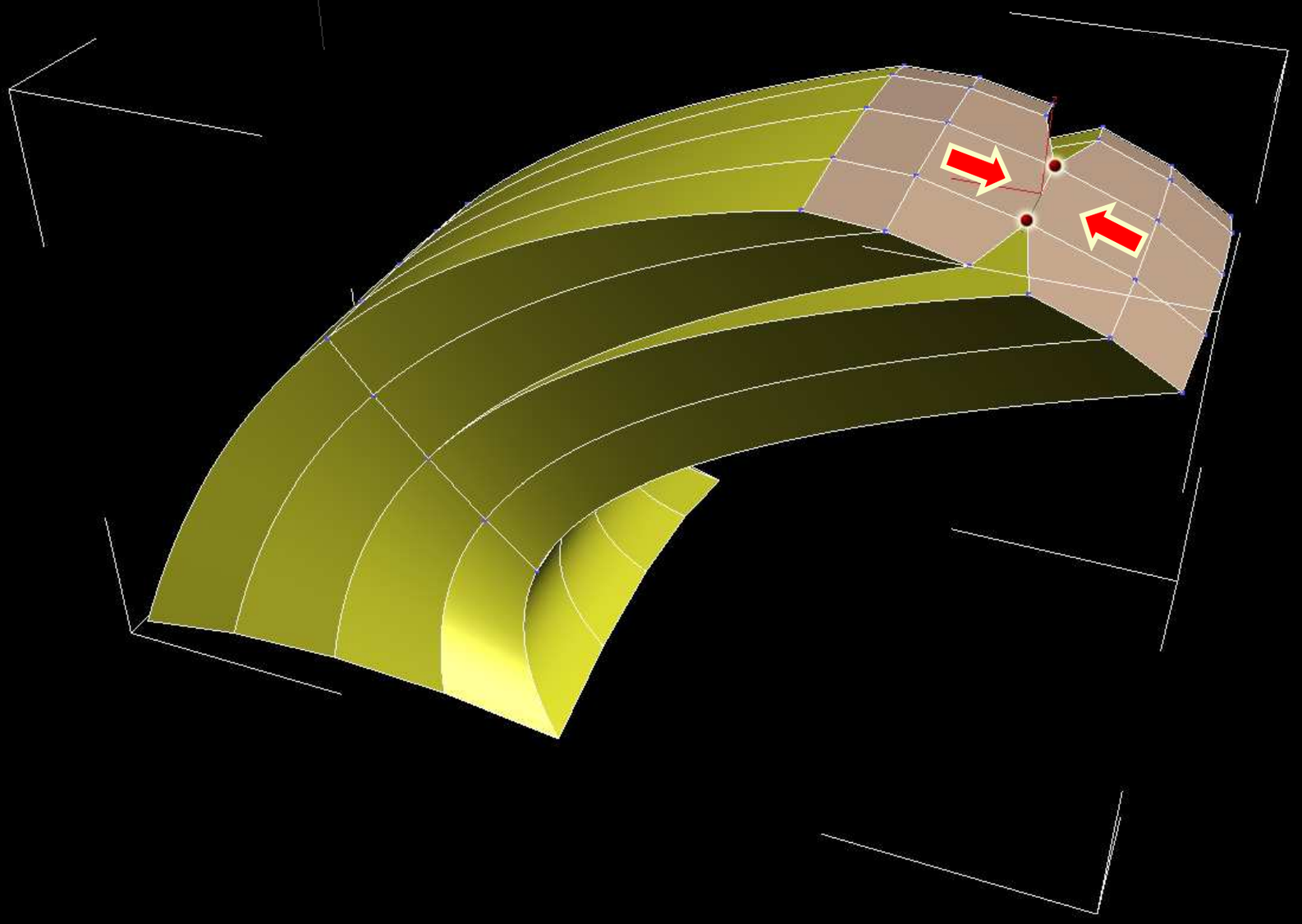
Topological Operations

- Edge/Vertex Weld



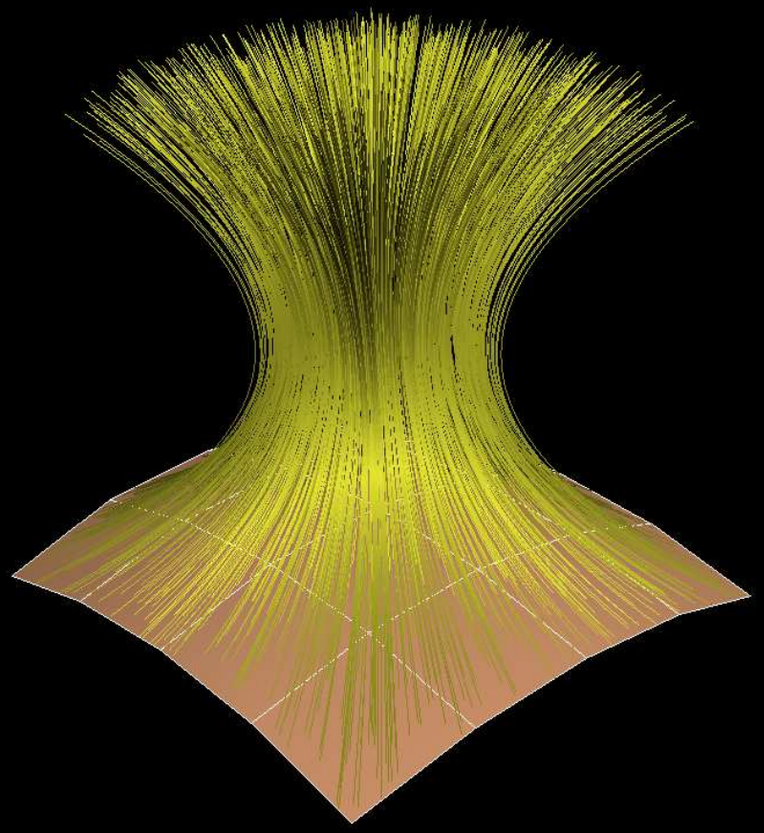
Topological Operations

- Edge/Vertex Weld



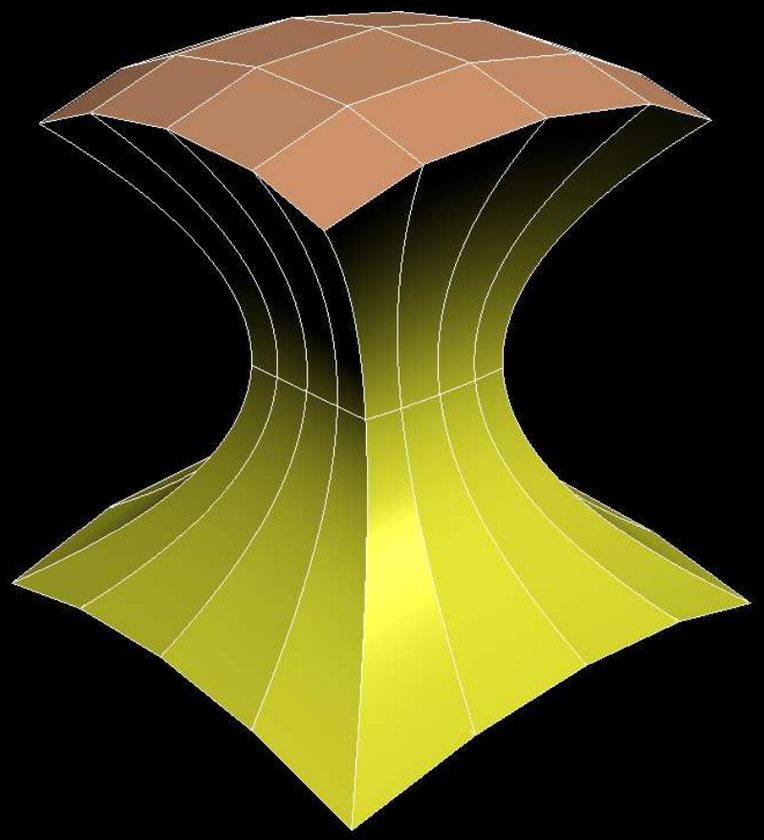
Topological Operations

- Edge/Face Divide and Subdivision



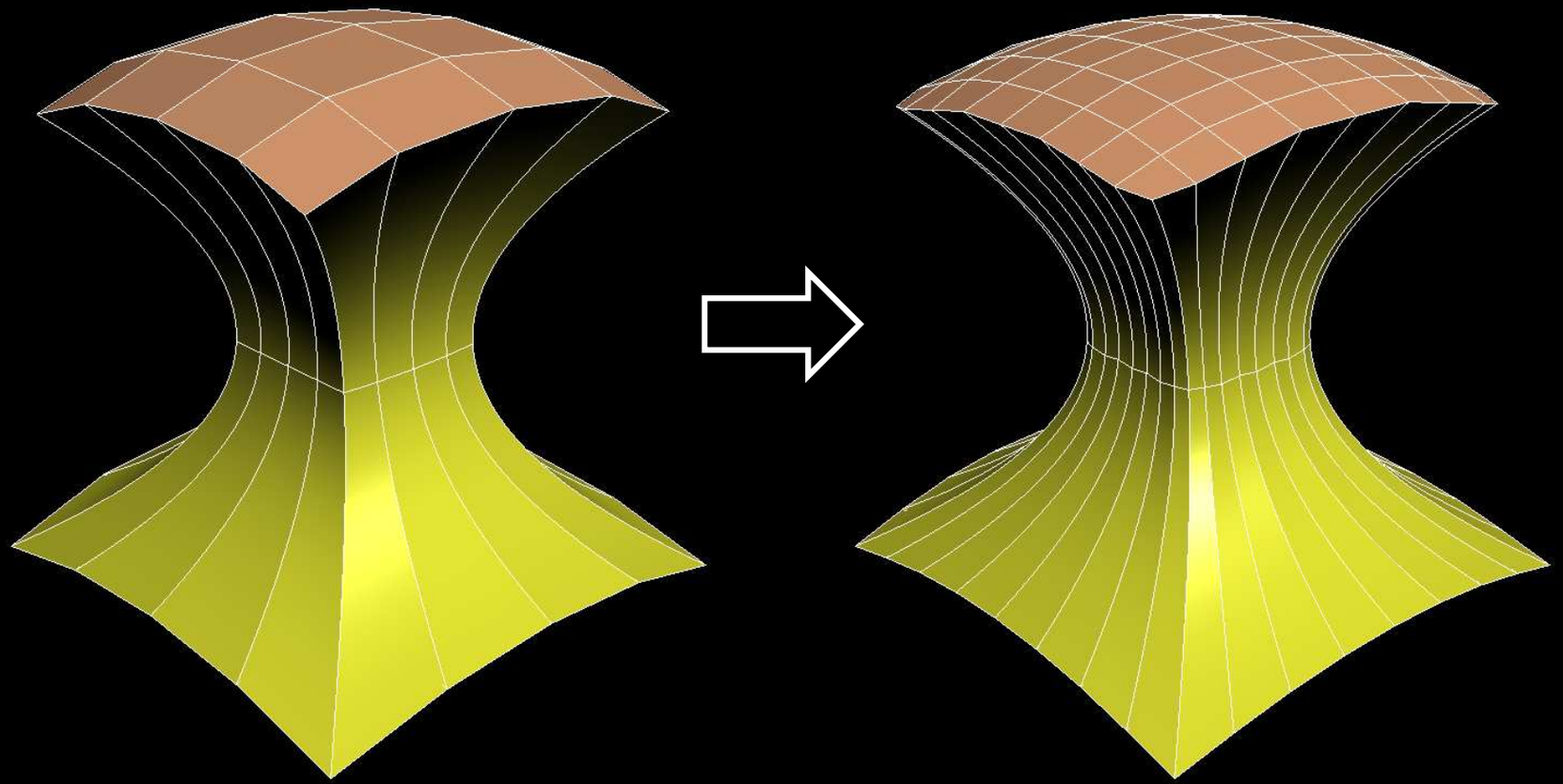
Topological Operations

- Edge/Face Divide and Subdivision



Topological Operations

- Edge/Face Divide and Subdivision

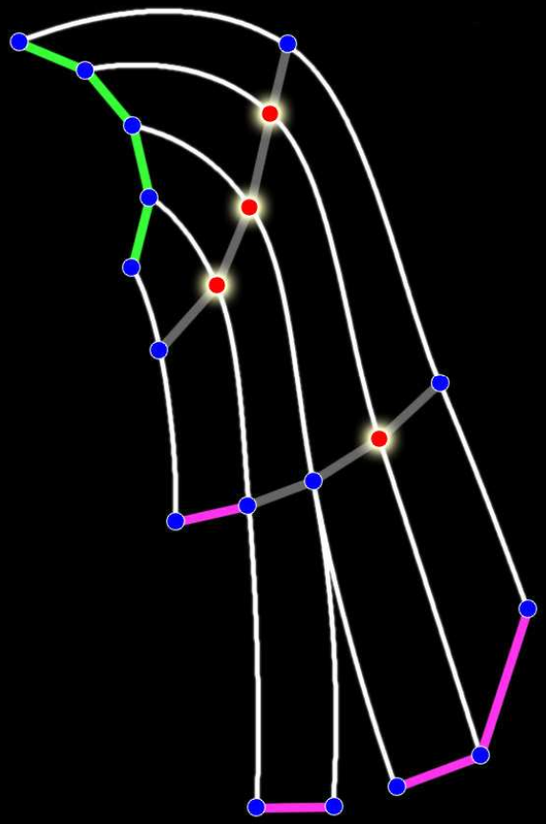


Hair Mesh

Geometrical Operations

Geometrical Operations

- User interacts with the external surface
- Internal structure is automatically shaped



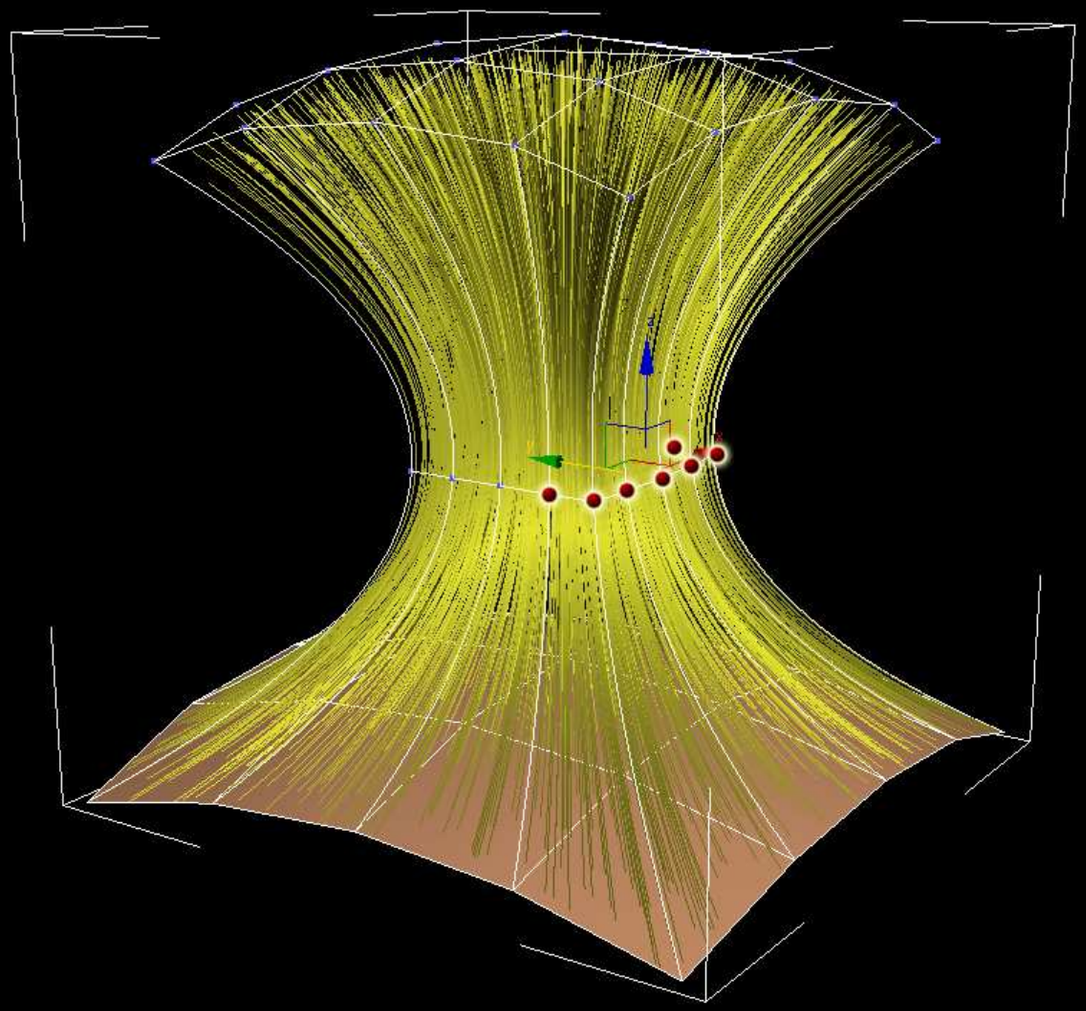
- External Vertices
- Internal Vertices

Geometrical Operations

- Internal Vertex Placement
  - Part of the modeling process
  - It has to be fast
  - Constrained quadric minimization
    - Operates on the whole hair mesh
    - External vertices are fixed
    - Error is the difference between tangent edges
      - Favor local uniformity
    - Initial conditions are the previous positions
    - Solved using Conjugate Gradients
      - Converges after a few iterations

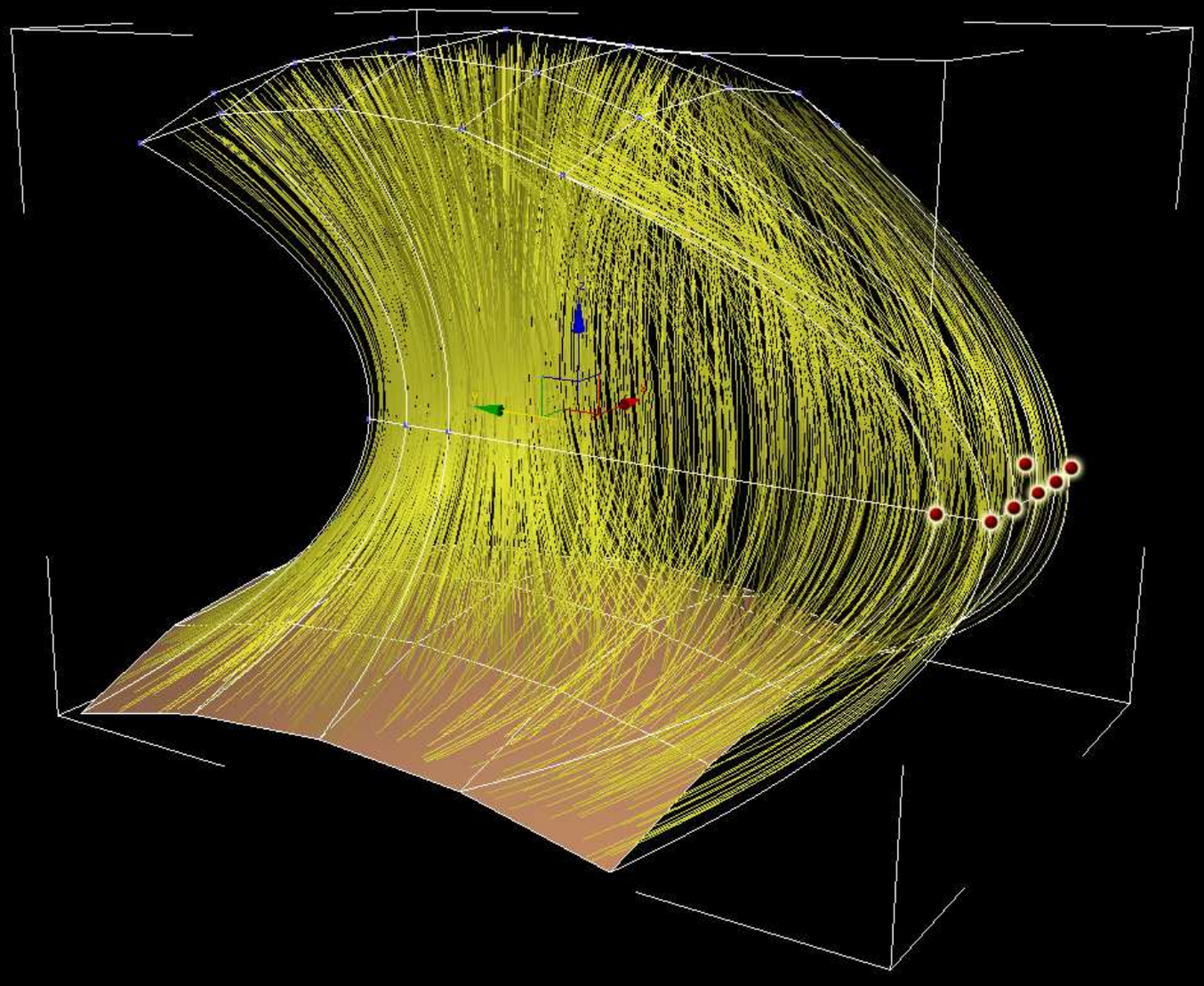
Geometrical Operations

- User SELECTs vertices to move



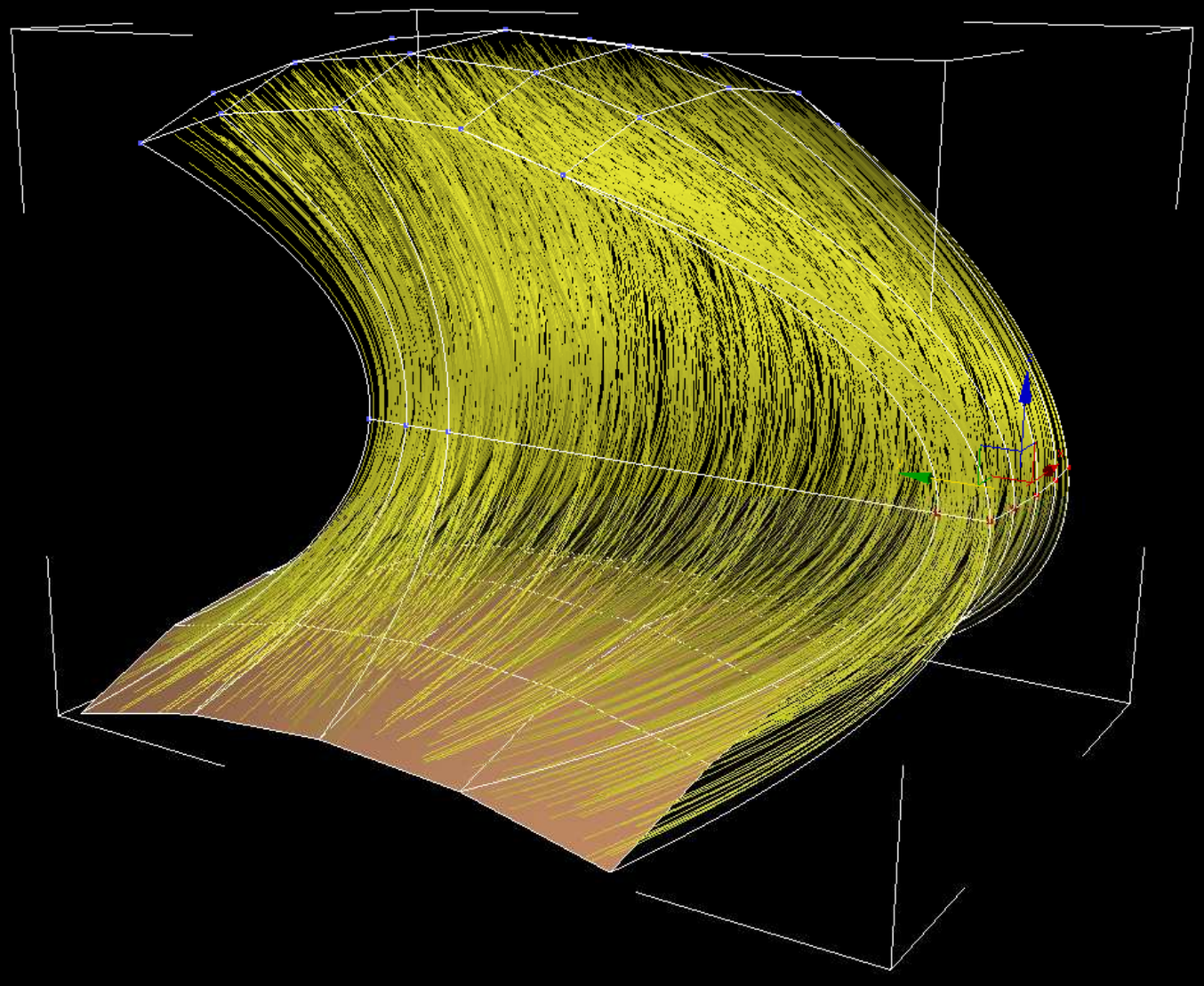
Geometrical Operations

- User MOVEs selected vertices



Geometrical Operations

- Internal vertices are automatically placed



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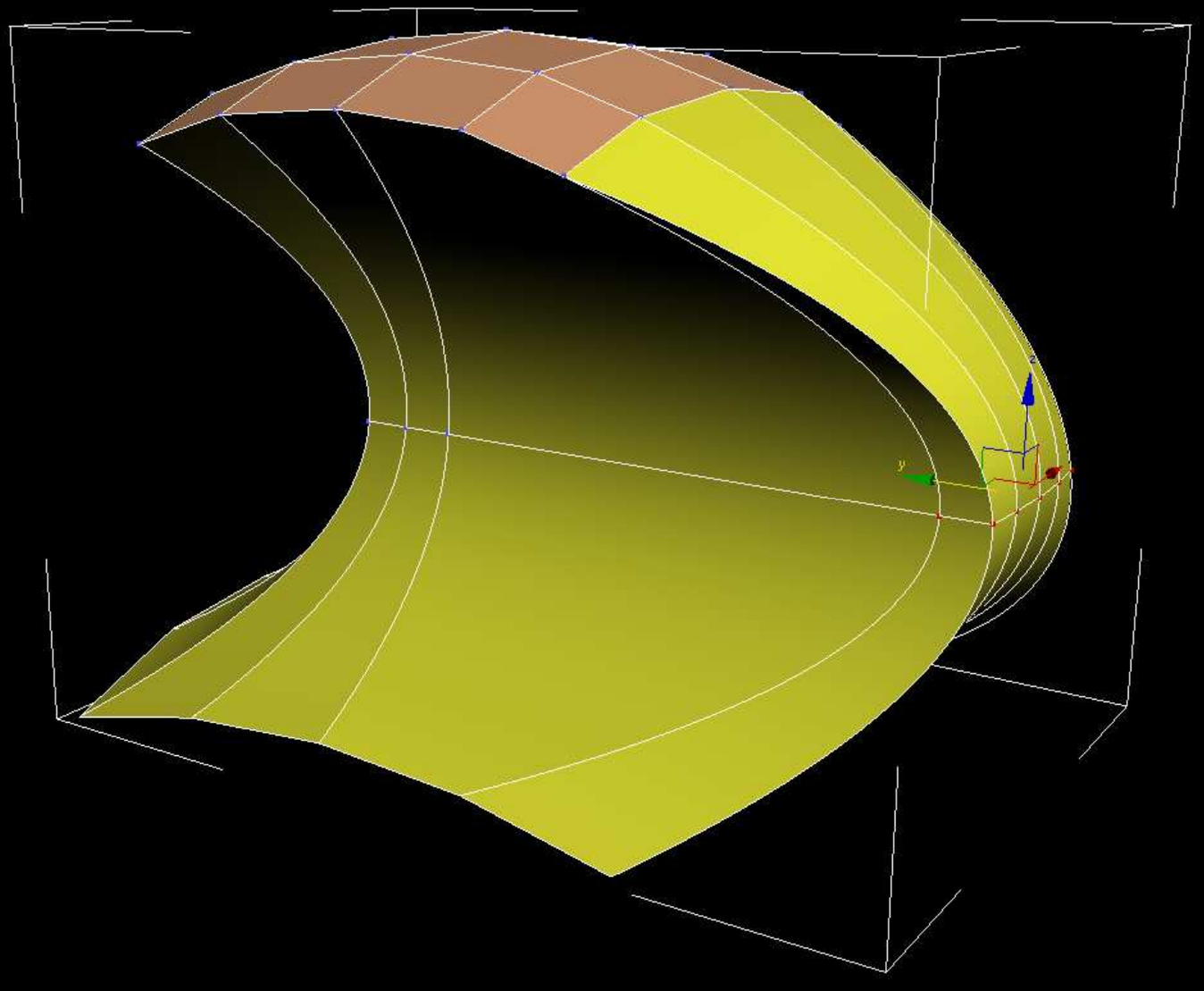
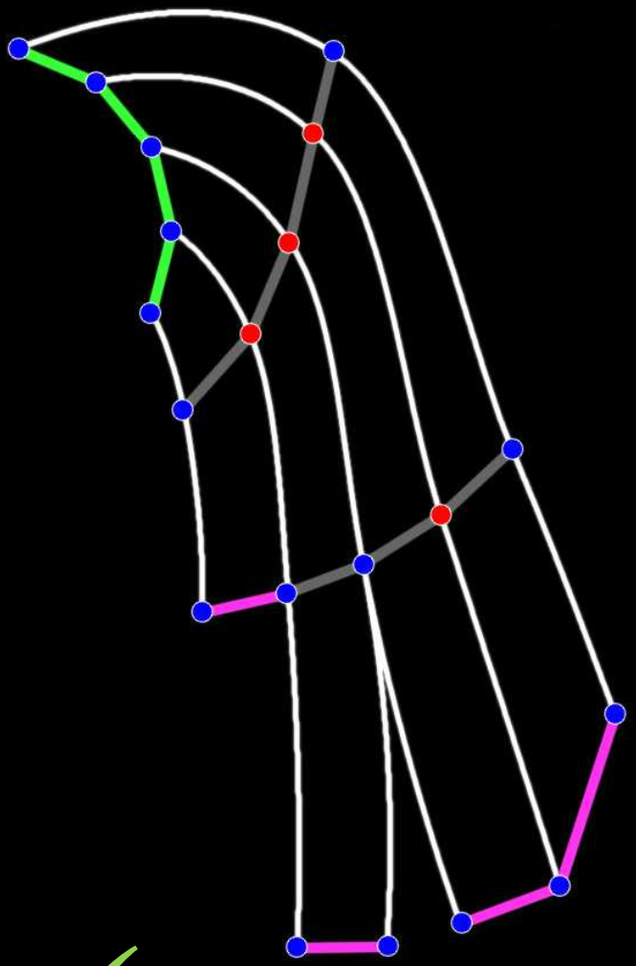
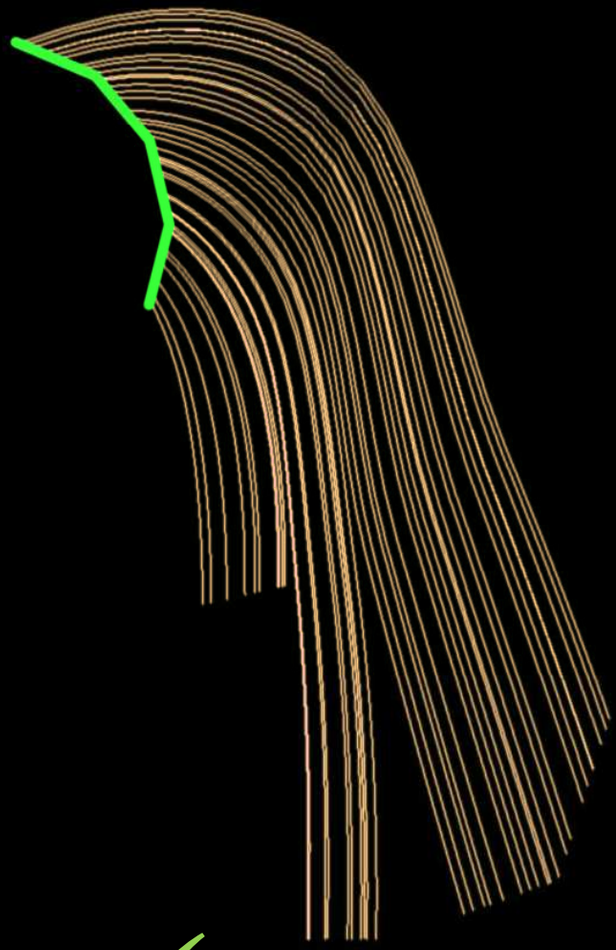


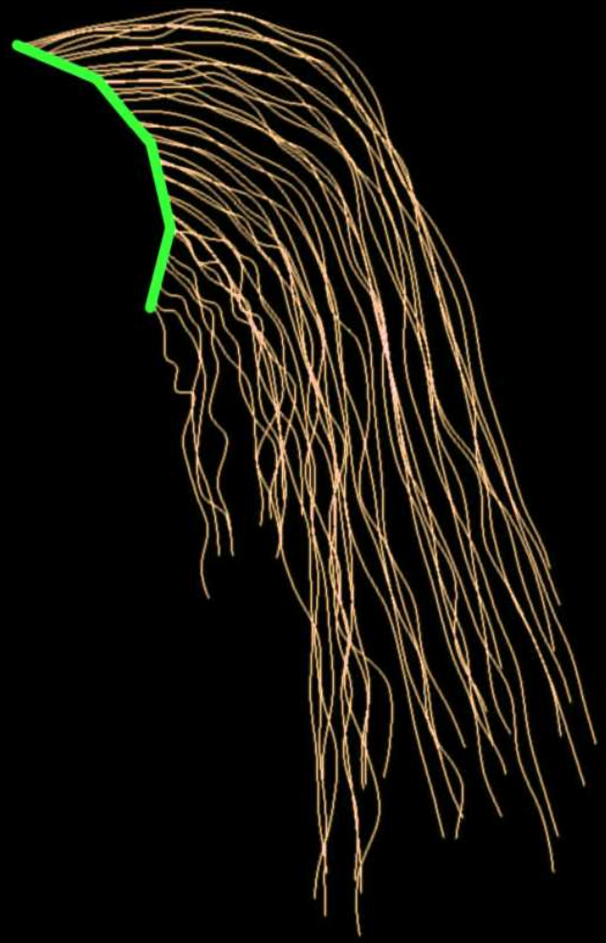
Hair Modeling with Hair Meshes



✓ Hair Mesh Modeling



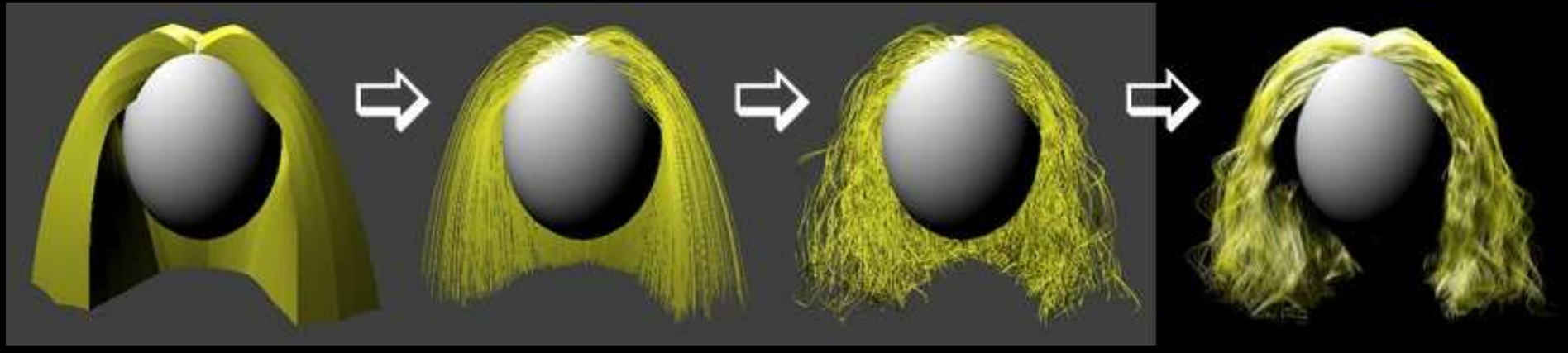
✓ Hair Generation



? Hair Styling

Hair Styling

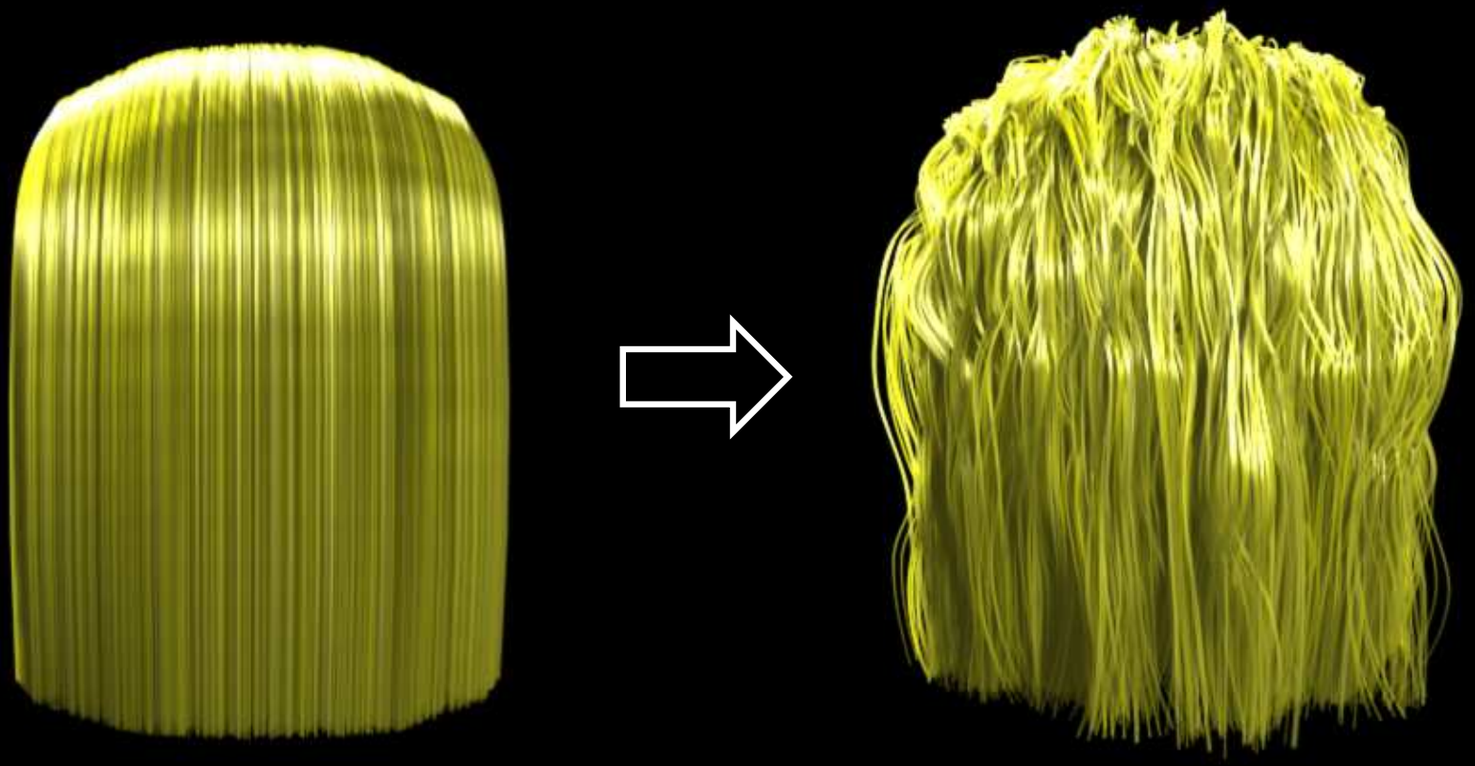
- All operations on hair strands are *styling* operations



Hair Mesh Modeling Hair Generation *Styling* Rendering

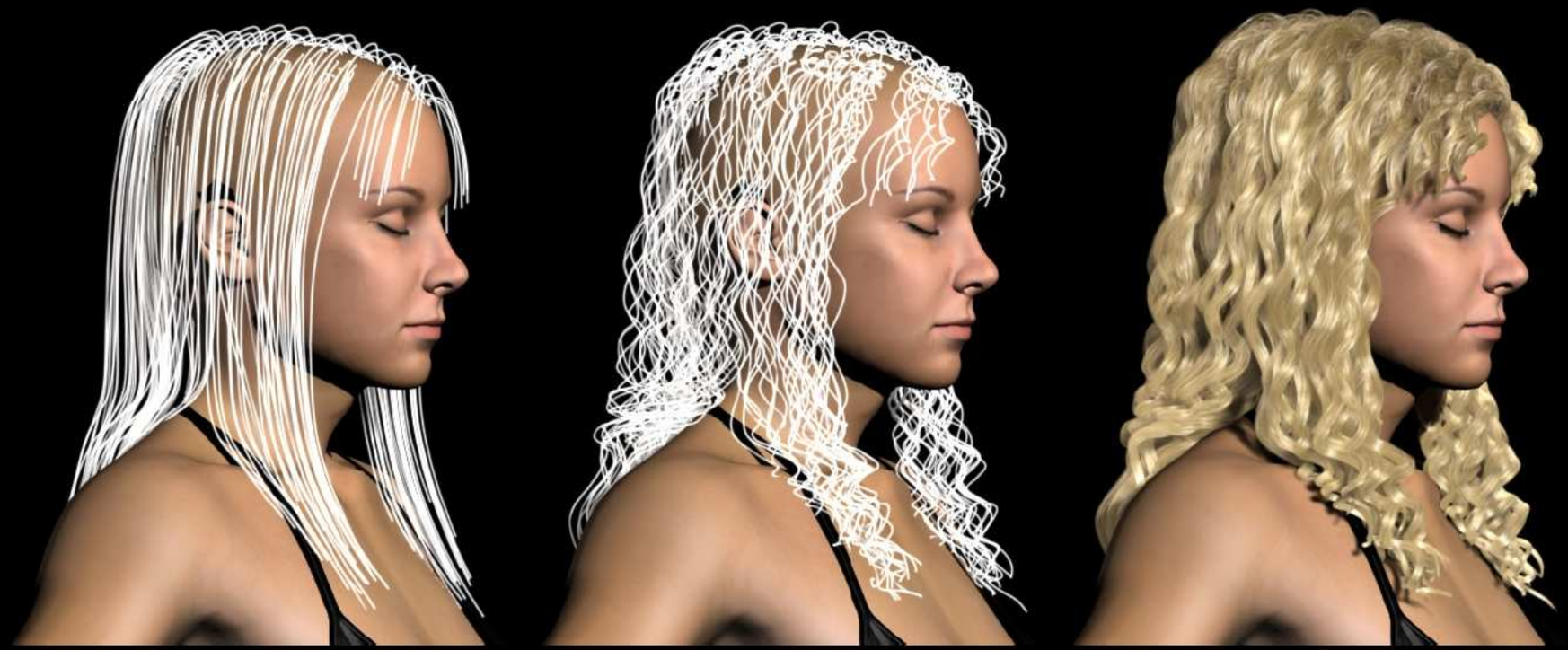
Hair Styling

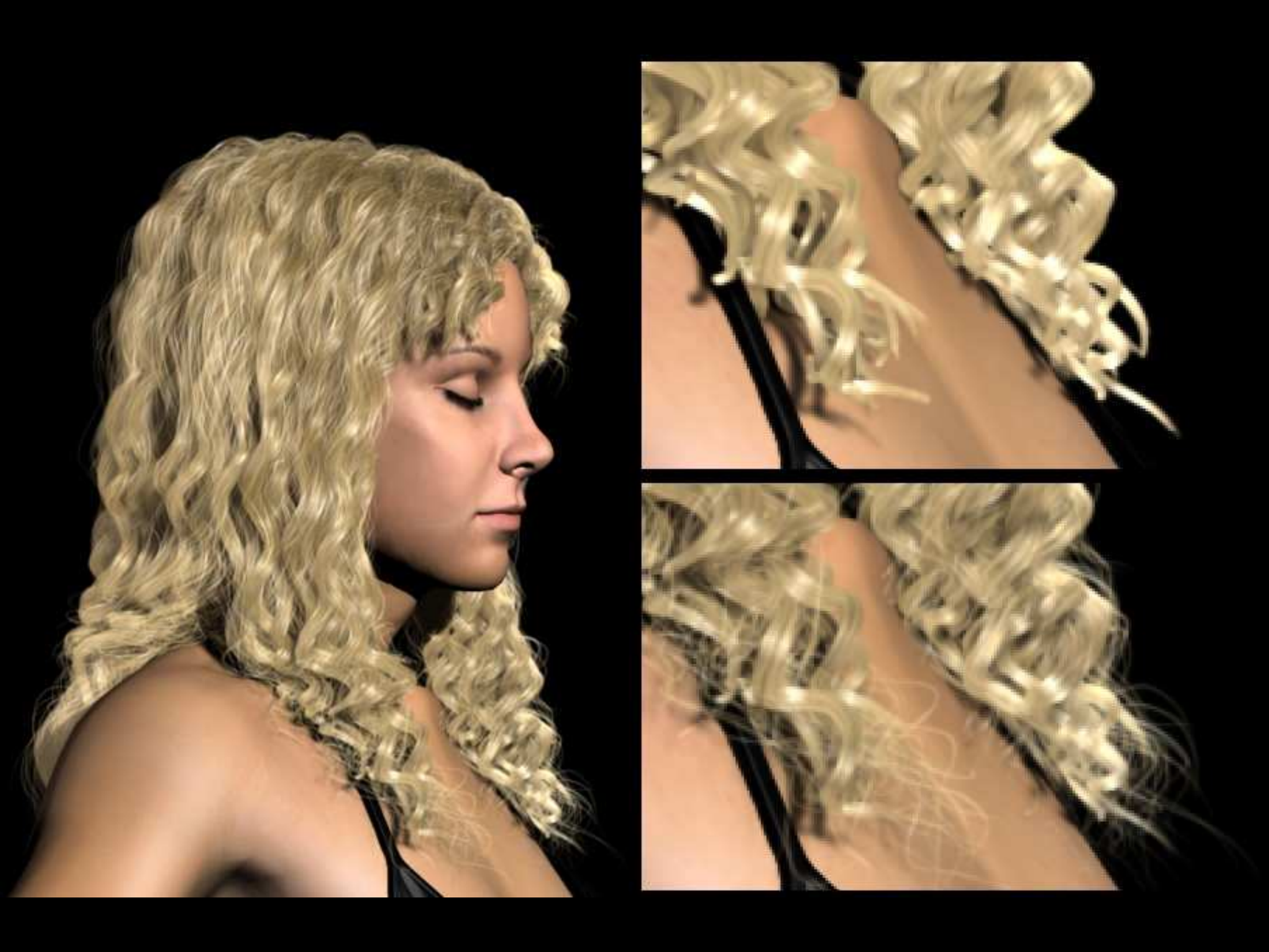
- All operations on hair strands are *styling* operations
- Procedural Styling



Hair Styling

- All operations on hair strands are *styling* operations
- Procedural Styling
- Combining with wisp-based methods

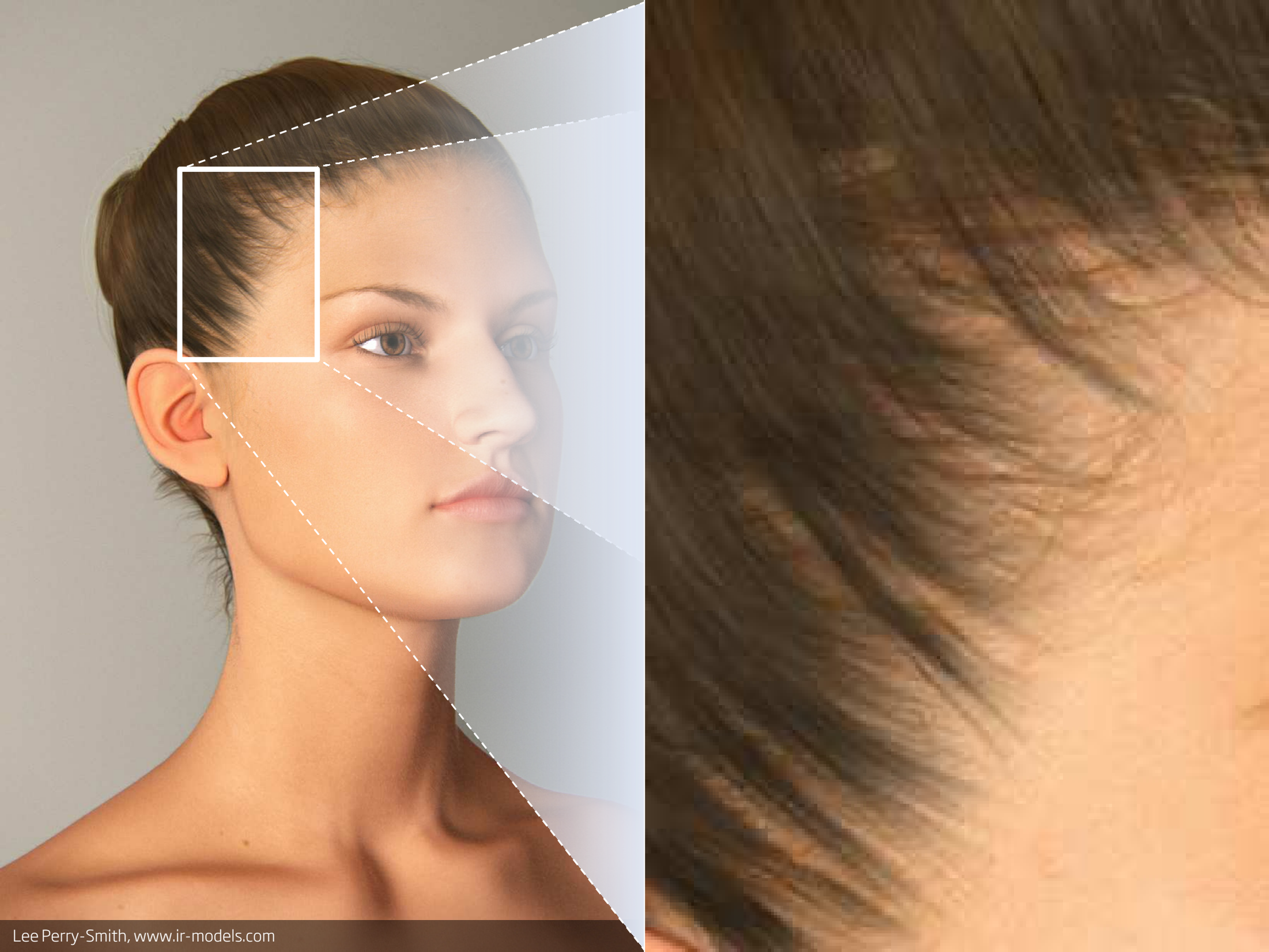




Hair Meshes

Results

Lee Perry-Smith, www.ir-models.com



Lee Perry-Smith, www.ir-models.com

Lee Perry-Smith, www.ir-models.com

Wrapping Up…

- Hair Meshes
  - Polygon-like modeling
  - Intuitive
  - —Direct Control

Lee Perry-Smith, www.ir-models.com

Thanks!

- Artists
  - Lee Perry-Smith
  - Alexander Tomchuk
  - Cedric Lepiller
  - Marc Mordelet
  - Luc Begin
  - Anish Mohan
  - Rune Spaans
  - Nildo Hassane Essa

Lee Perry-Smith, www.ir-models.com

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Lee Perry-Smith, www.ir-models.com

HAIRFARM™
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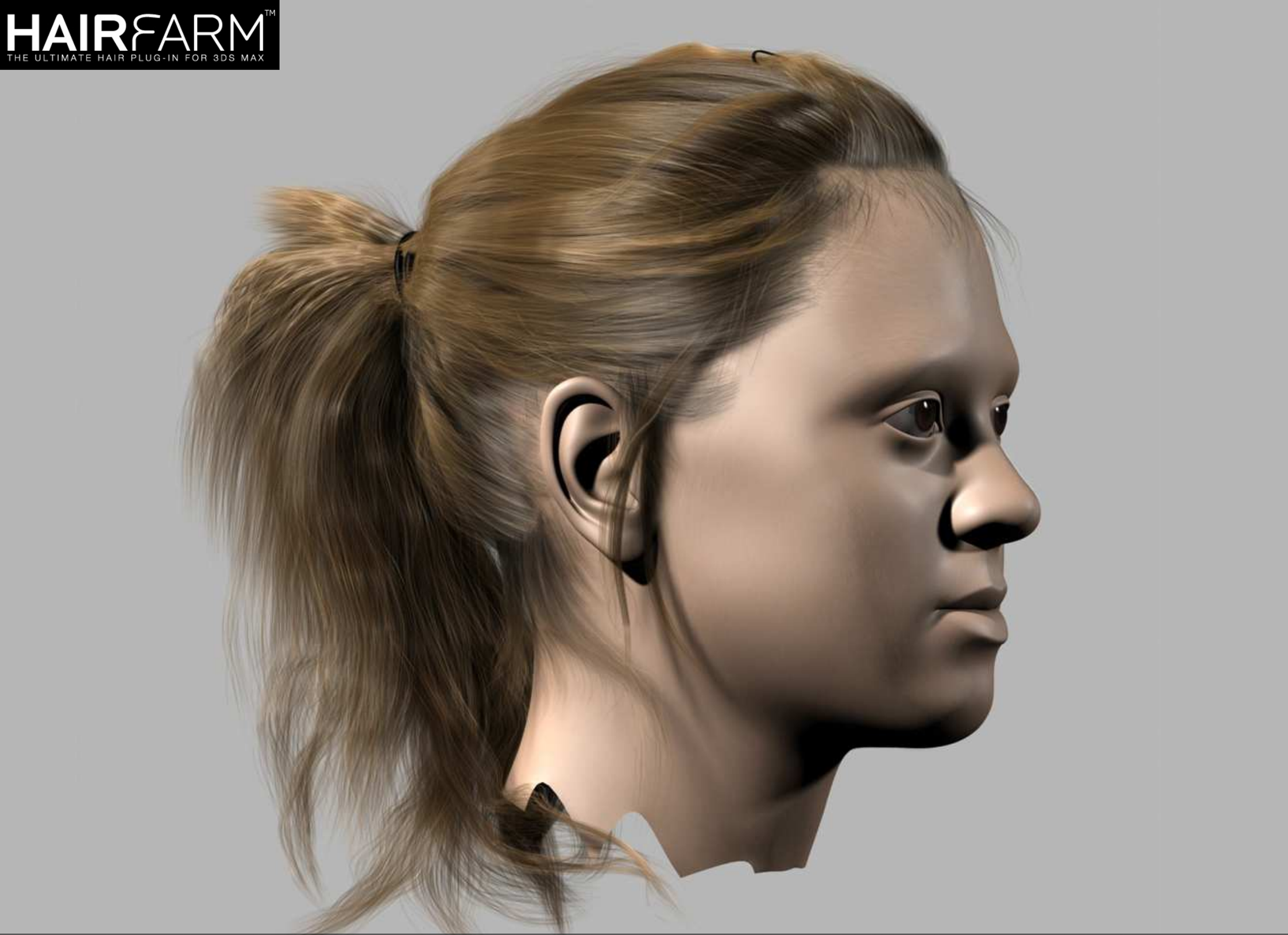

Luc Begin, bigguns.cgsociety.org

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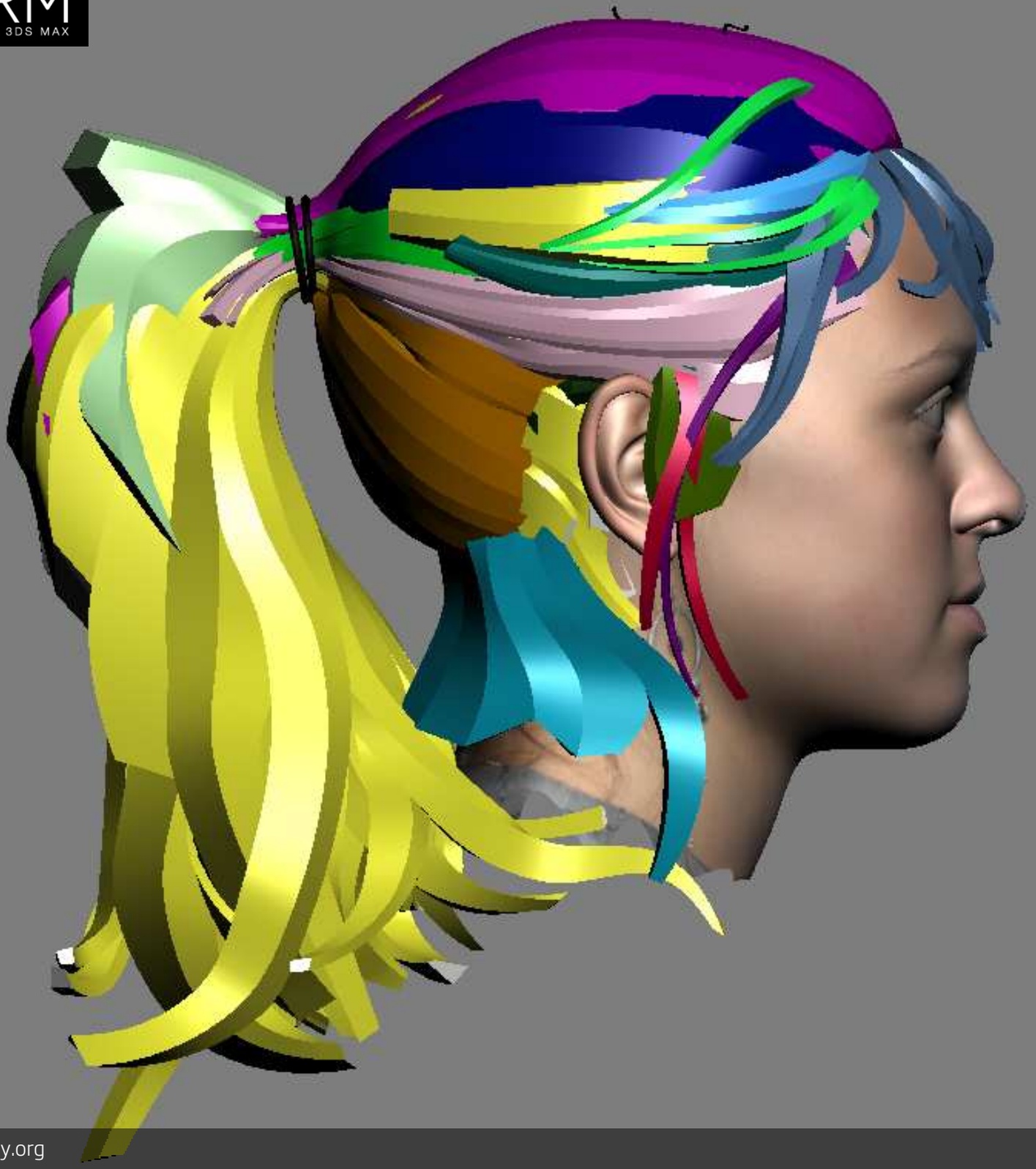

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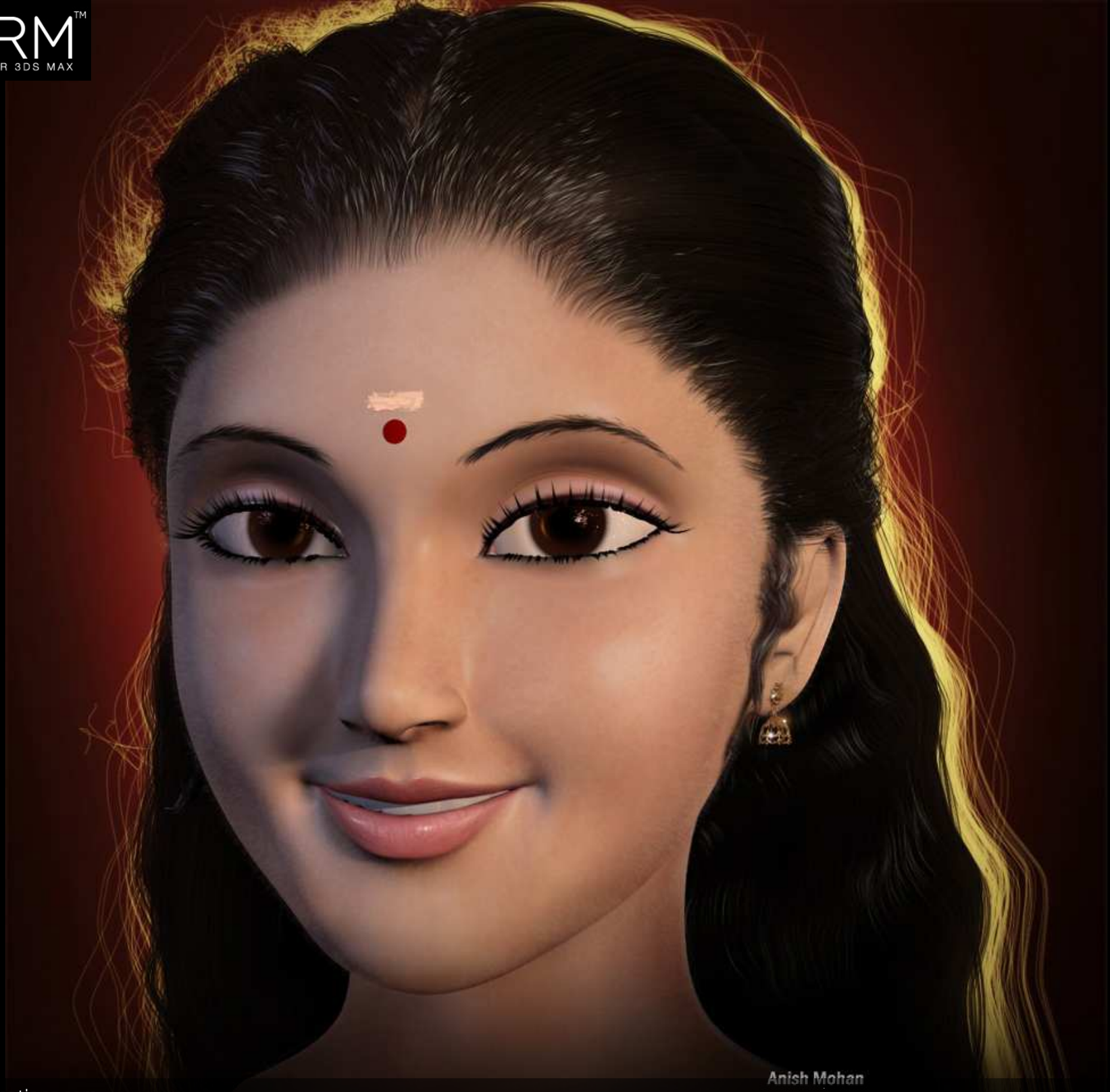

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Character design : Siju Thomas
Anish Mohan
hair created using HAIRFARM™

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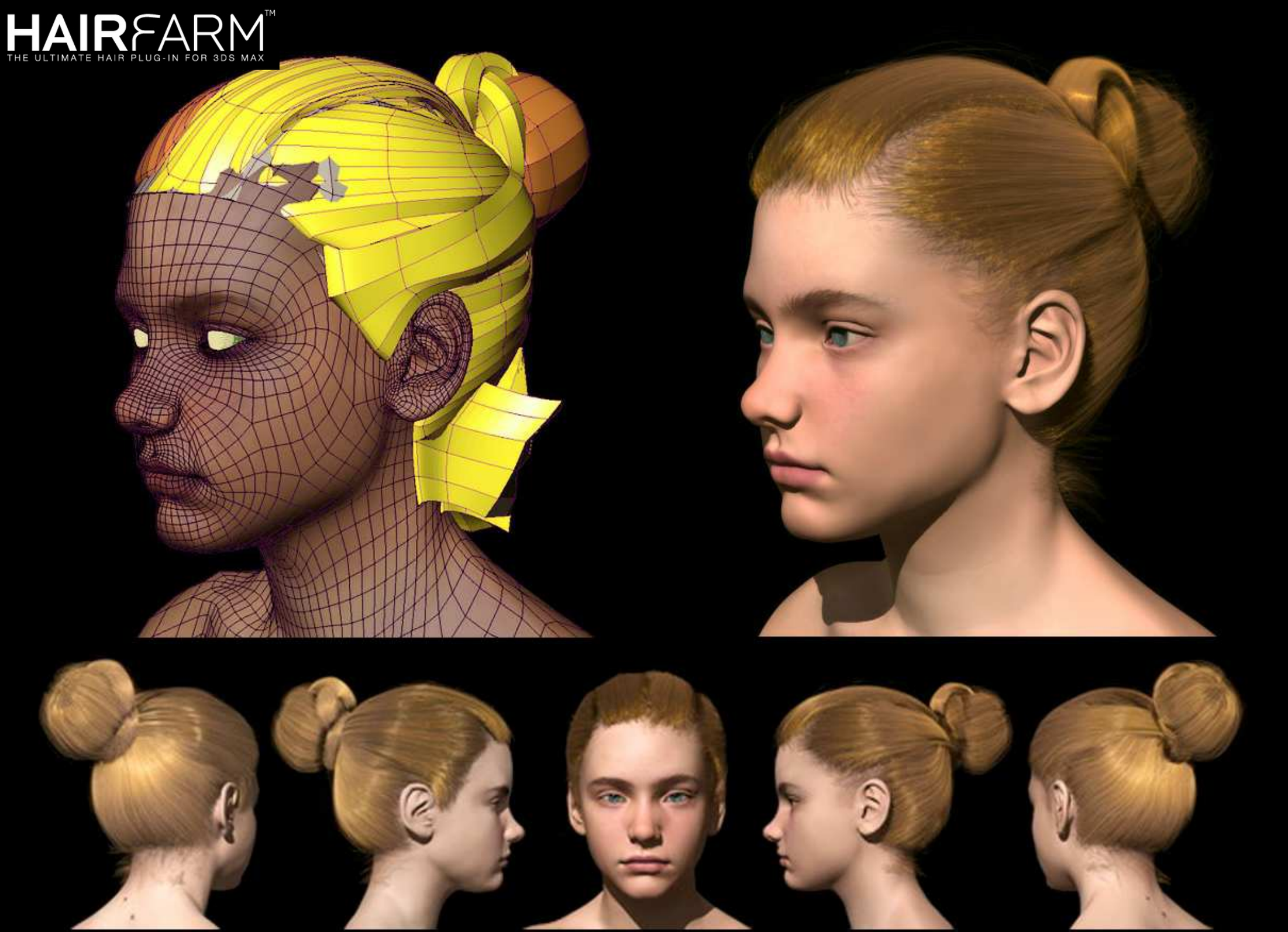

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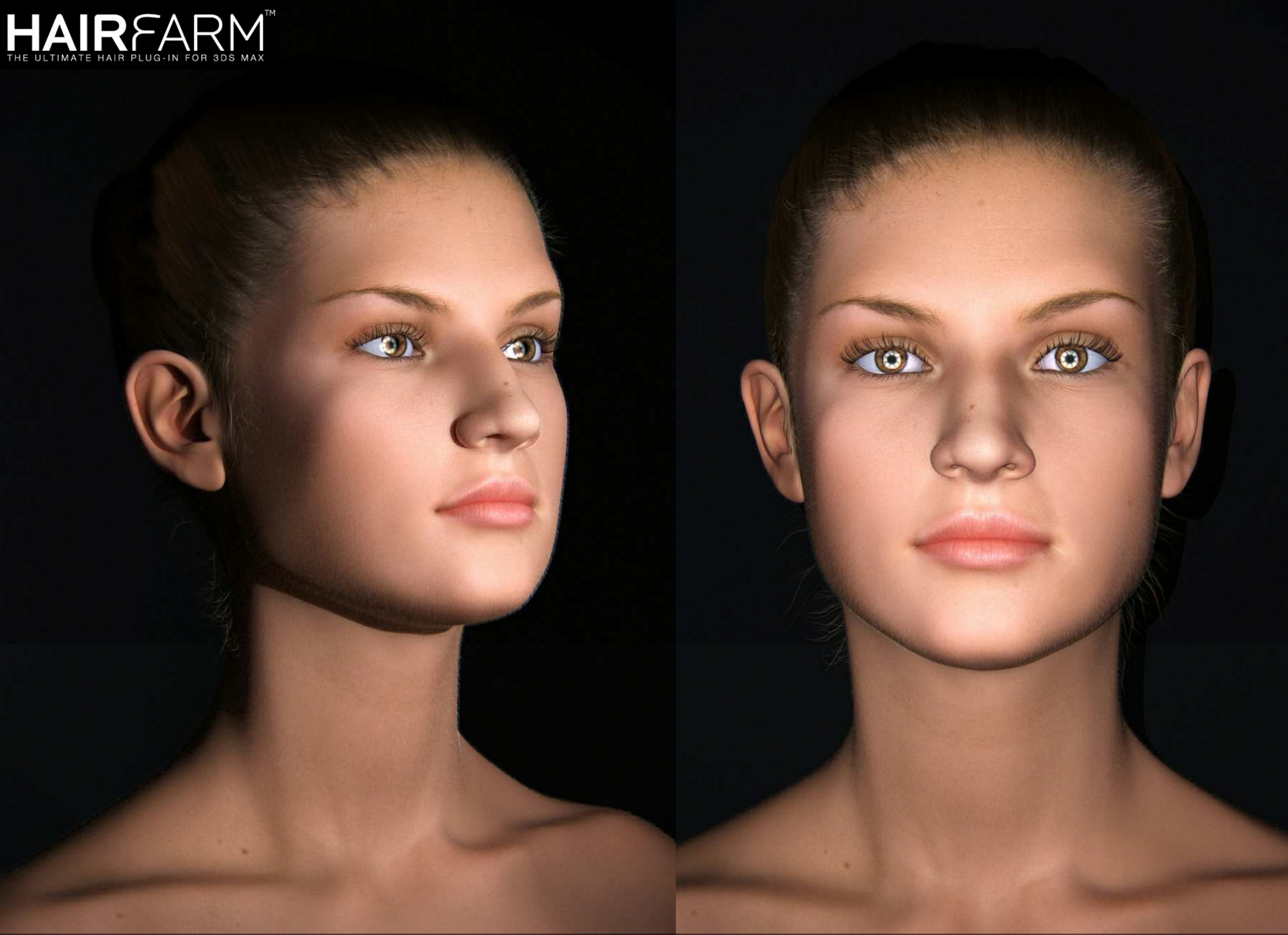

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