Welcome to CS838!
Topics In Computing: Advanced Computer Graphics

Fall 2015, 2:30-3:45 MW

Today's lecture

- Discuss scope of class, and indicative topics
- Clarify class logistics
  - Communication mechanisms
  - Assignments
  - Evaluation procedure
- Give an example of a topic that ***YOU*** might present in class
  - Significant part of your evaluation
  - An opportunity to sharpen communication & presentation skills
- (Time permitting …) a few details about your instructor
- Next lecture:
  - *First topic : Point-based modeling (and reading assignment due!)*

Scope

- What is the class about?
  - Gaining *exposure* to modern computer graphics principles
  - Covering fundamentals, at enhanced depth
  - Also a taste of current trends (in research or industry)
- Who is this class for?
  - Accessible by graduate students in all areas
  - Advanced (post CS559) undergrads, too
  - Prior exposure to visual computing is assumed
  - Should be somewhat comfortable with programming
  - Enthusiasm a must!

Topics

- Modeling and geometry
  - Point-based models
  - Implicit surfaces
  - Meshing
  - Mesh optimization and processing
  - Differential geometry

Topics

- Rendering
  - Global illumination
  - Rendering equation - radiosity
  - Photon mapping
  - Image-based rendering

Topics

- Shape manipulation
  - Laplacian mesh processing
  - Shape morphing
  - Non-rigid registration
  - Parameterization

Topics

- Animation
  - Character skinning
  - Facial animation
  - Motion editing and control
  - Performance-driven animation

Topics

- Dynamics
  - Cloth animation
  - Contact & collision
  - Rigid body simulation
  - Intro to fluids simulation

Topics

- Various cool stuff
  - Sound modeling
  - Interactive rendering
  - Shape synthesis
  - General-purpose GPU use

Logistics

- Location : Computer Sciences 1257, MW 2:30-3:45pm
- 3 units, core credit eligible
- Course website : http://pages.cs.wisc.edu/~cs838-1
  - Check for lecture notes, announcements & weekly assigned readings
- Office hours : CS6387 MW 10:00-11:00am
  - Regular office hours only on days when class meets (excl. holidays)
  - Other times by appointment
- Mailing list : comsci838-1-f15@lists.wisc.edu
  - Please email the instructor if you are not automatically enrolled (e.g. auditing)
- Online discussion : Piazza (post here for your reading assignment!)
- Email policy:
  - Typically within 24hrs
  - Worst case : you will get a reply by the time of next office hours
  - Use piazza whenever possible

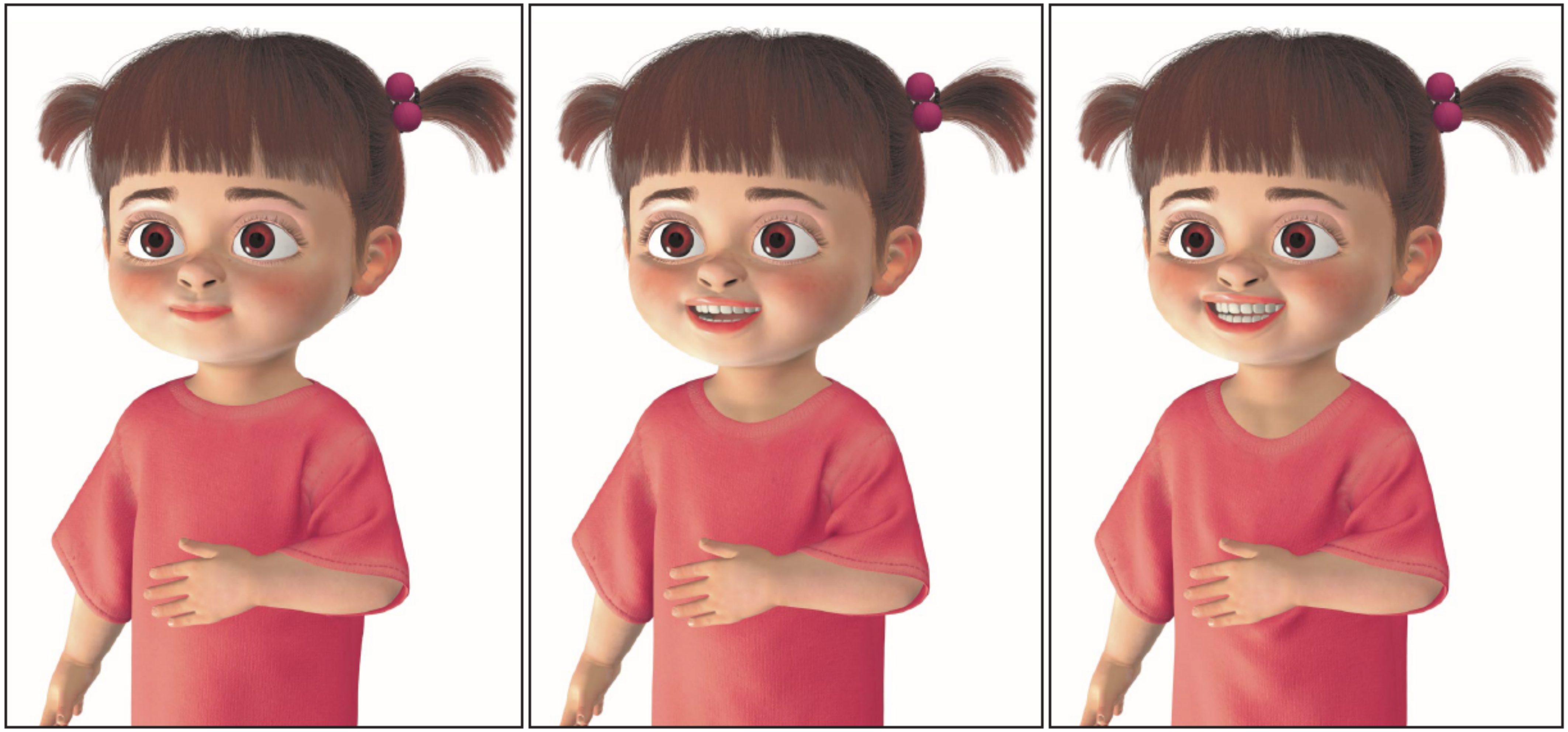
Evaluation

- 3 parts ("loosely" equally weighted)
  - Reading assignments, In-class Presentation, Project
- Reading assignment
  - Due : day before first class of *every* week
    (usually Sunday, but Tuesday for next week)
  - Submit on Piazza!
  - Part I : A 1-2 paragraph summary of *one* of the papers you were assigned to read
  - Part II : Eight questions/comments/points of critique
    - Each about 1-3 sentences
    - Can be a question you had when reading the paper
    - Or an observation (not explicitly given in the paper)
    - Or an answer to another student's question

Evaluation

- 3 parts ("loosely" equally weighted)
  - Reading assignments, In-class Presentation, Project
- Presentation assignment (example to follow)
  - Starting week 3
  - Each student presents once, 15min slot.
  - Must prepare and run by instructor at least 1 week ahead of time.
  - List of papers & signup forms : to be posted on webpage
- Programming project
  - Individual (unless an exceptional case arises)
  - Open-ended, with guidance from instructor.
  - 2 progress milestones (end of Sept, end of Oct)
  - Deliverable : last week of classes
- No final

Preparing a presentation assignment

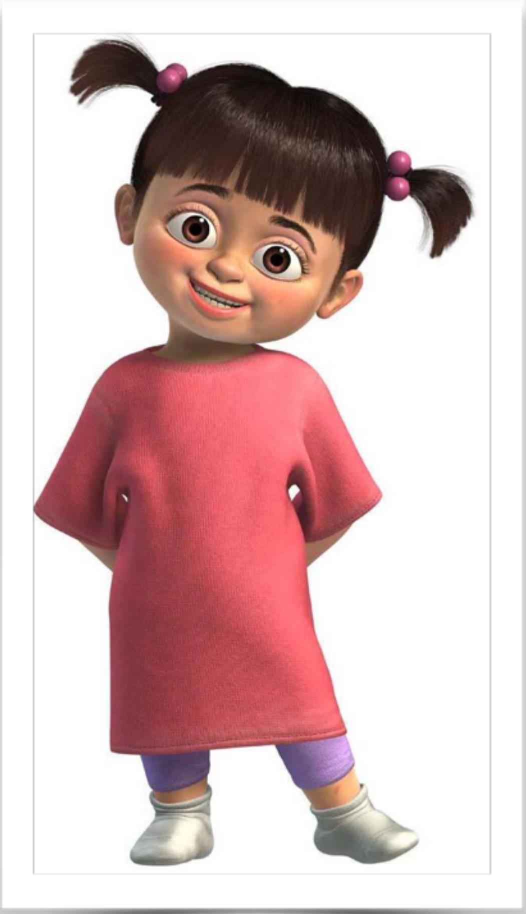


Untangling Cloth (ACM SIGGRAPH 2013)

David Baraff, Andrew Witkin and Michael Kass
Pixar Animation Studios

Introduce the paper & authors

Overview



(c) Monsters Inc

- Cloth simulation is an extremely popular effect in feature films

In simple and concrete terms (minimal jargon), what does the paper do?

Overview

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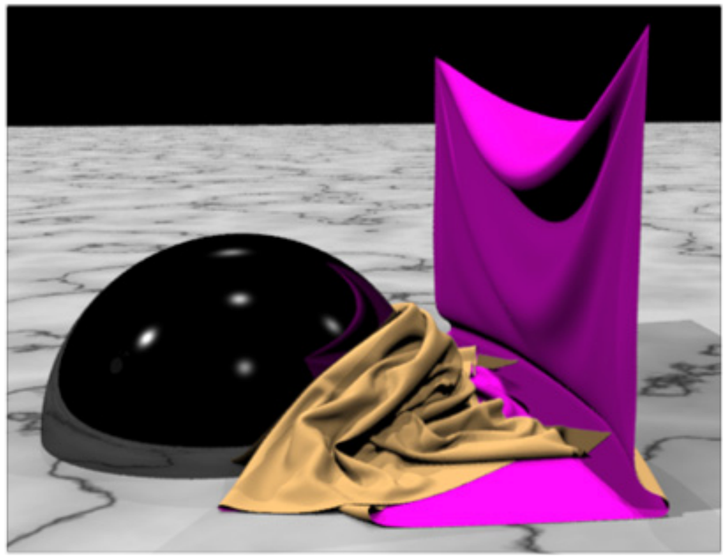

Bridson et al, SIGGRAPH 2002

- Cloth simulation is an extremely popular effect in feature films
- Collisions are what makes cloth behavior exciting

In simple and concrete terms (minimal jargon), what does the paper do?

Overview

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- Cloth simulation is an extremely popular effect in feature films
- Collisions are what makes cloth behavior exciting
- We don’t want tangling, but sometimes it’s unavoidable
- This method allows simulation to tolerate & recover from tangles

In simple and concrete terms (minimal jargon), what does the paper do?

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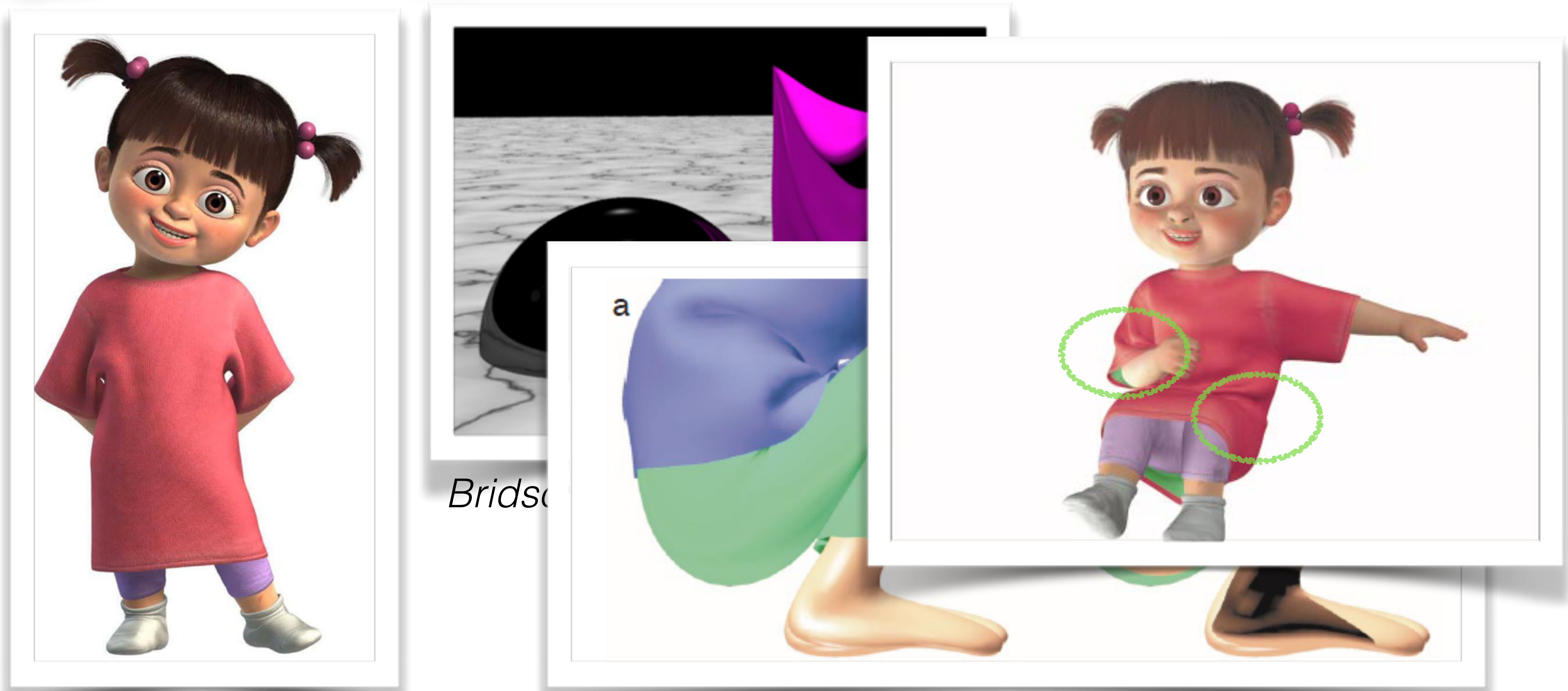

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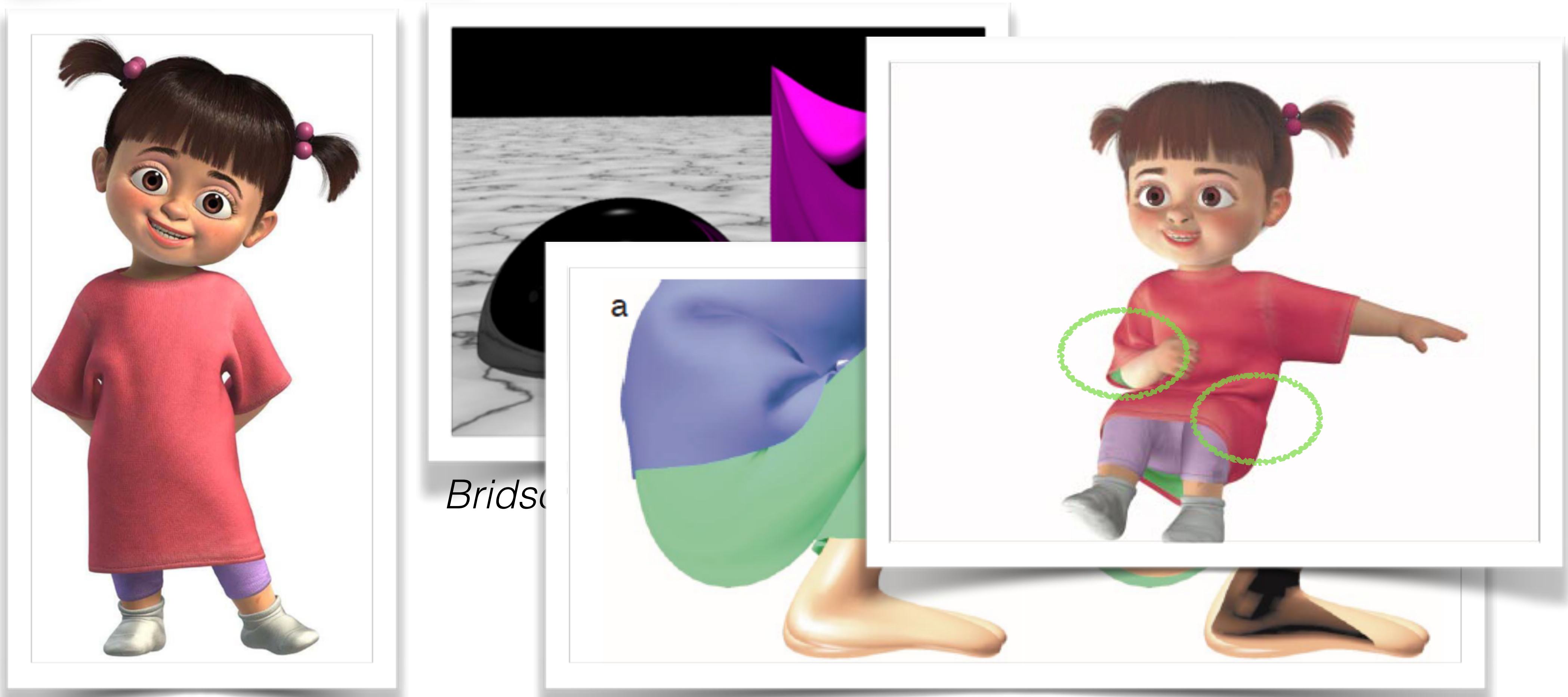

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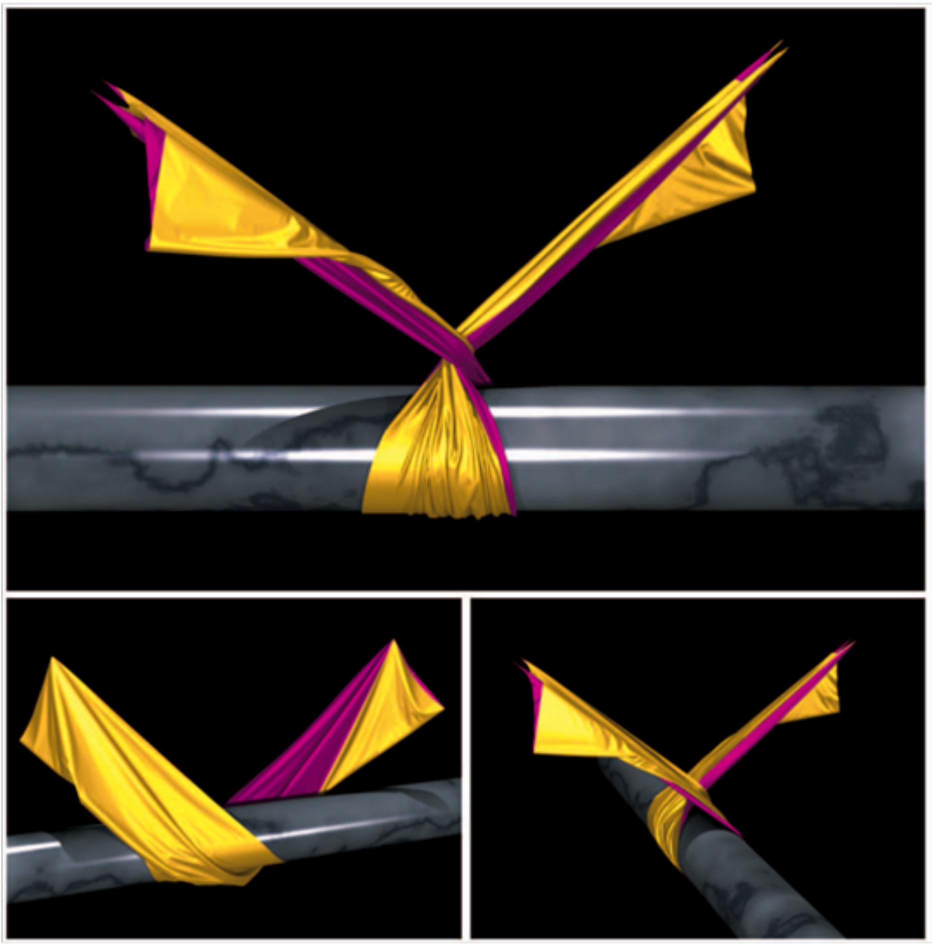
(try to explain why we even care about this!)

Background



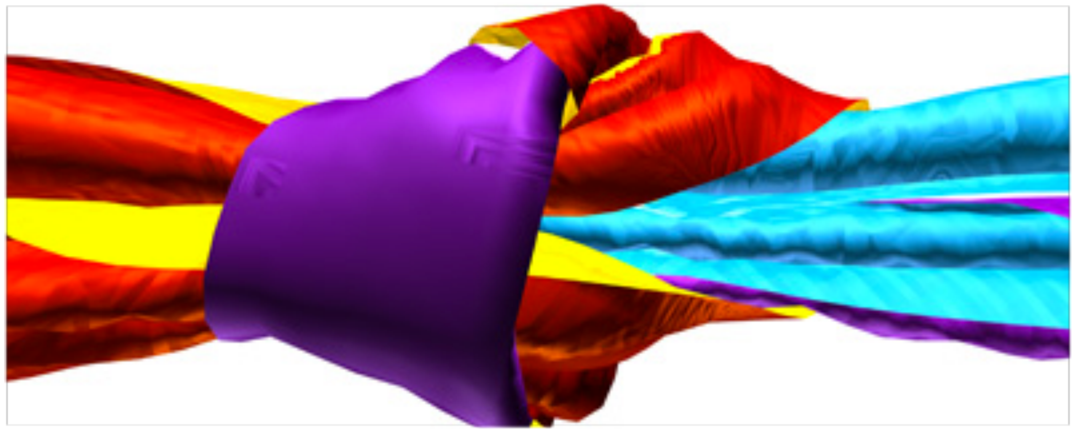
Bridson et al, SIGGRAPH 2002

Popular (prior) approaches:

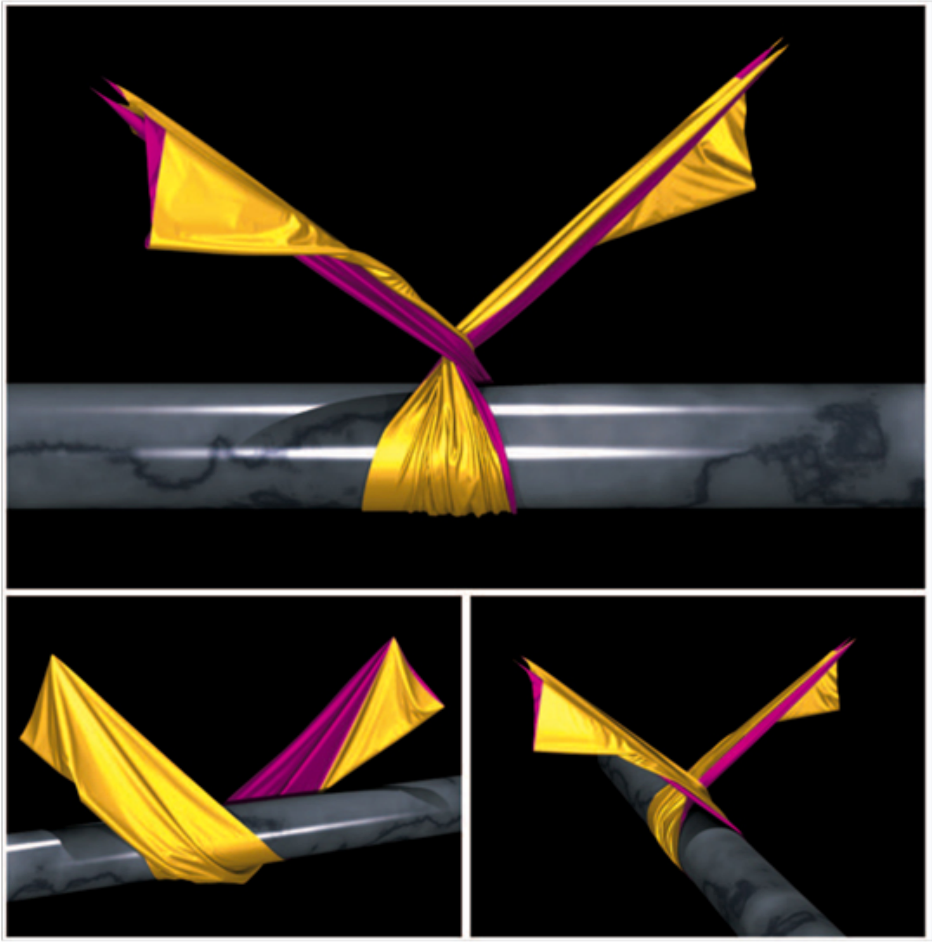
- Option A : Make sure nothing is ever tangled

How did we arrive at this problem?
What have others done to deal with it?

Background



Harmon et al, SIGGRAPH 2009



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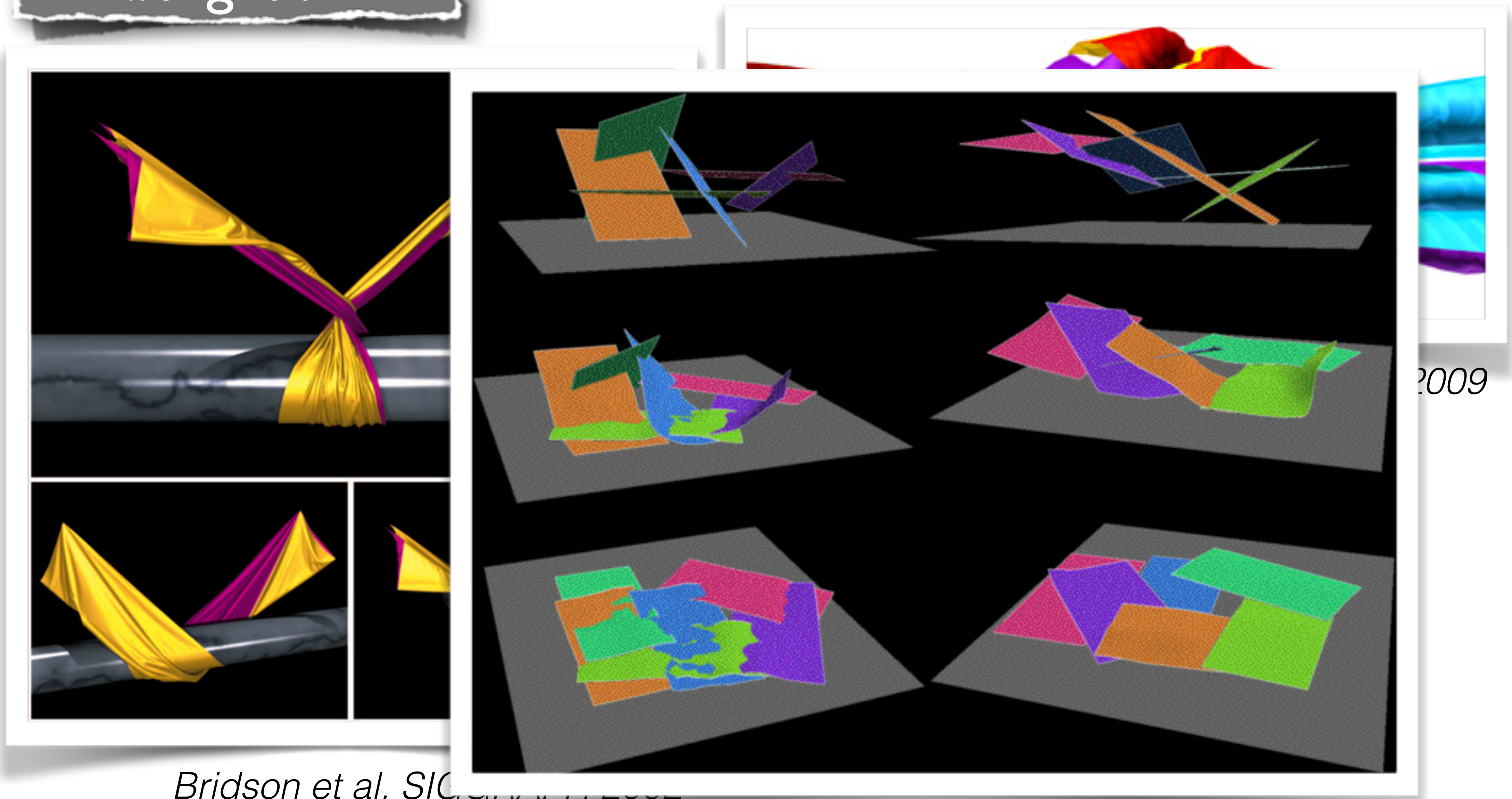


Bridson et al, SIG

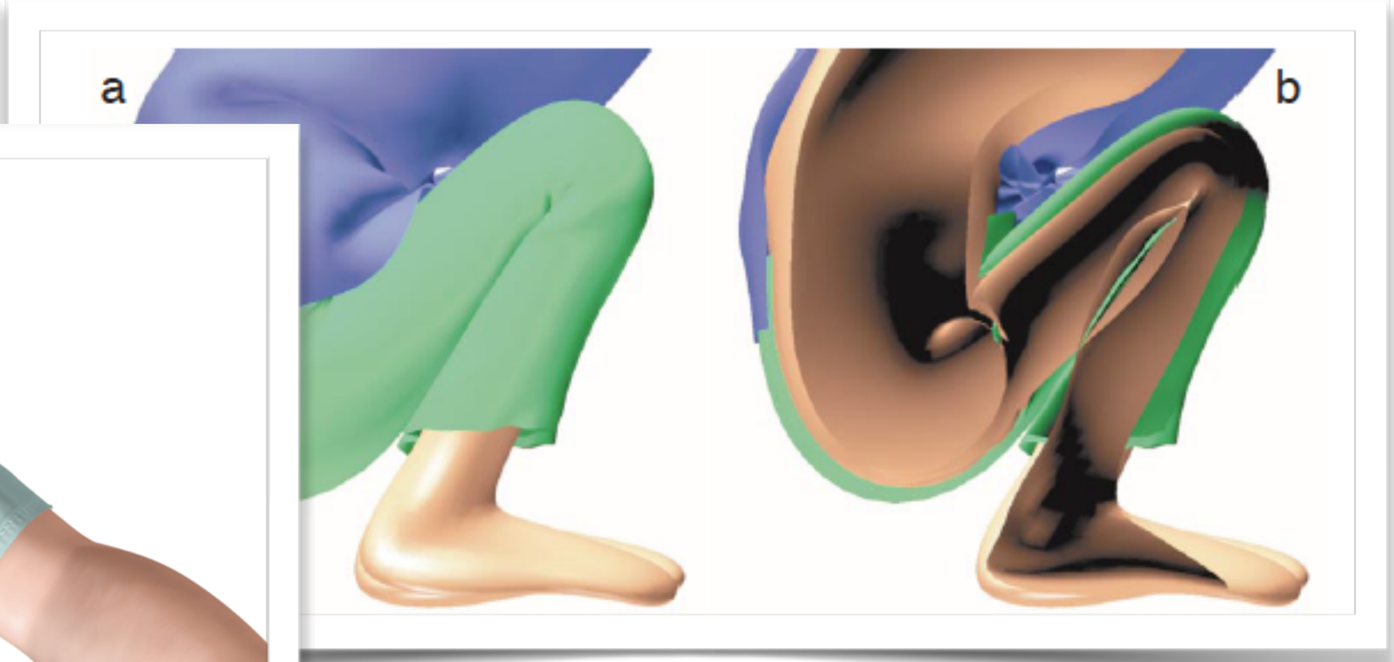
Volino et al, SIGGRAPH 1995

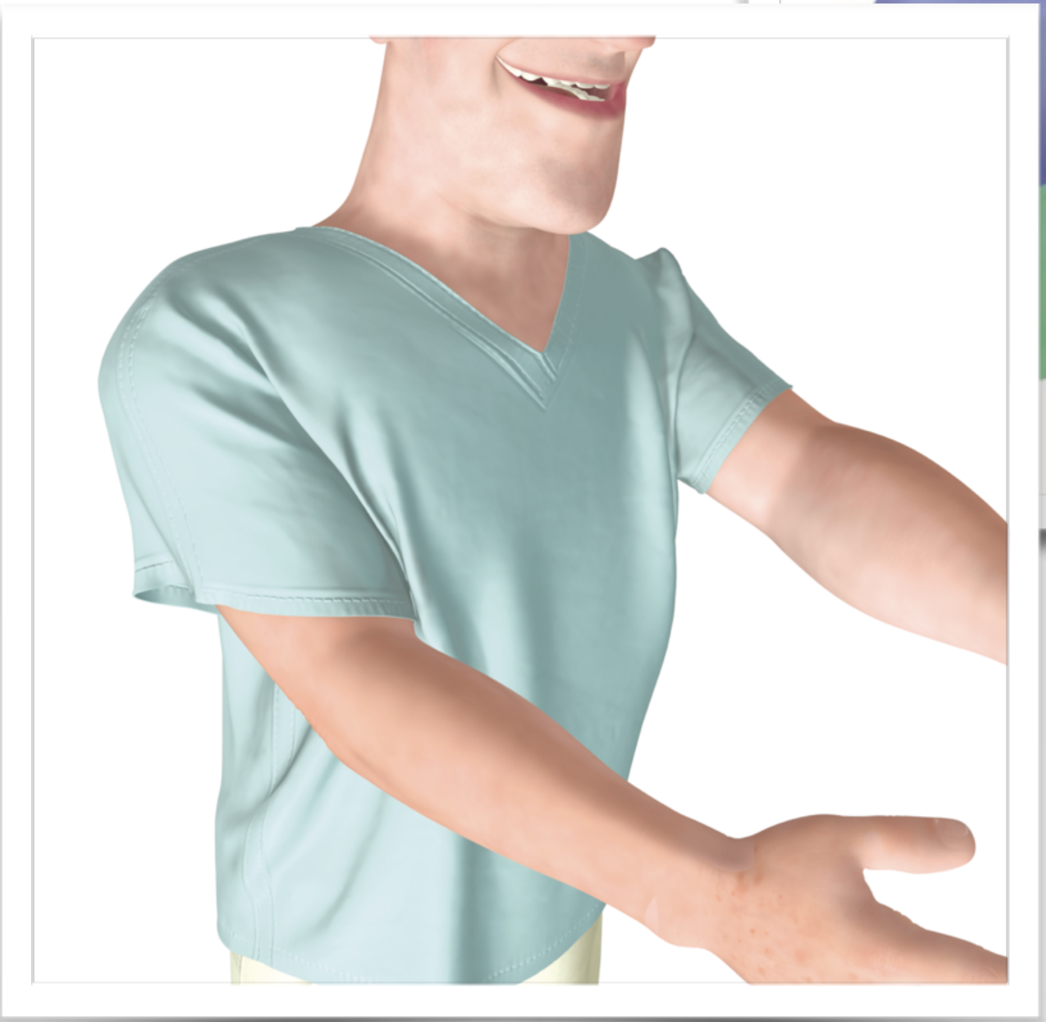
Popular (prior) approaches:

- Option A : Make sure nothing is ever tangled
- Option B : Keep history of what side the cloth "came from"

How did we arrive at this problem?
What have others done to deal with it?

Challenges



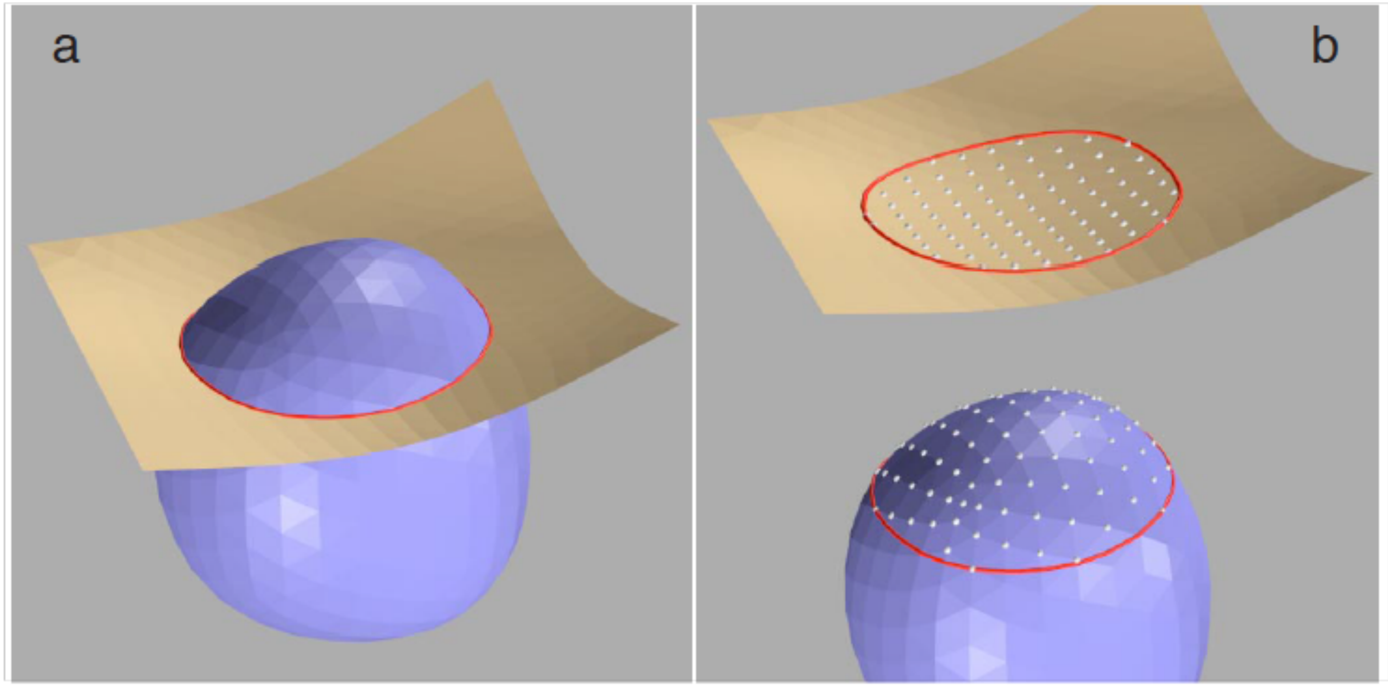


Challenges

- Animation constraints often trigger deep interpenetration
- Not always clear how a tangled scenario should resolve

Why is this problem difficult?
(why was this solution a research paper?)

Approach

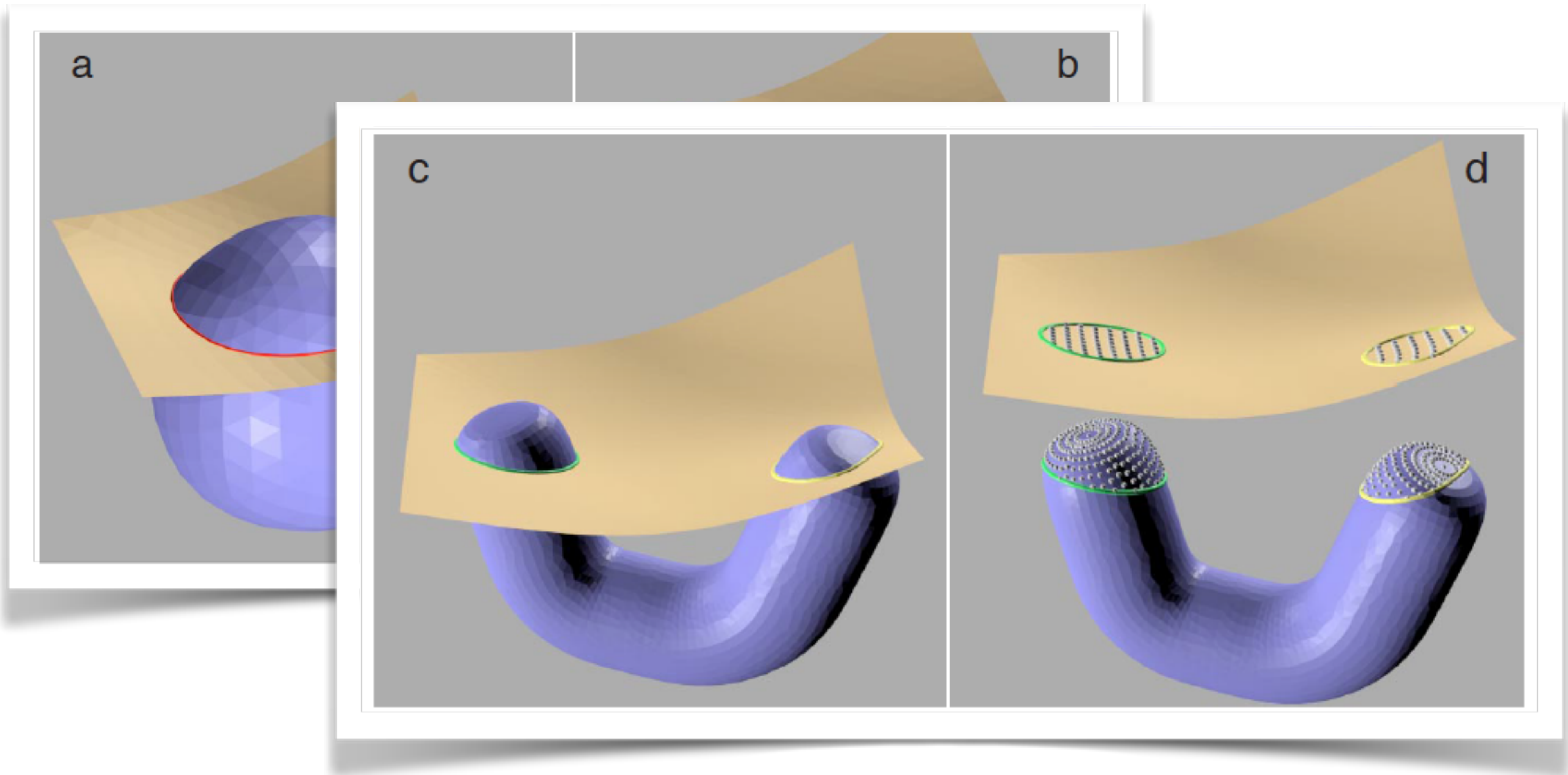


Approach

- Compute the *curves* along which surfaces intersect
- Identify regions enclosed by such curves (flood fill)
- Color each curve (and associated region) based on connectivity

Summarize the technical approach
(be intuitive; use math only if really necessary)

Approach



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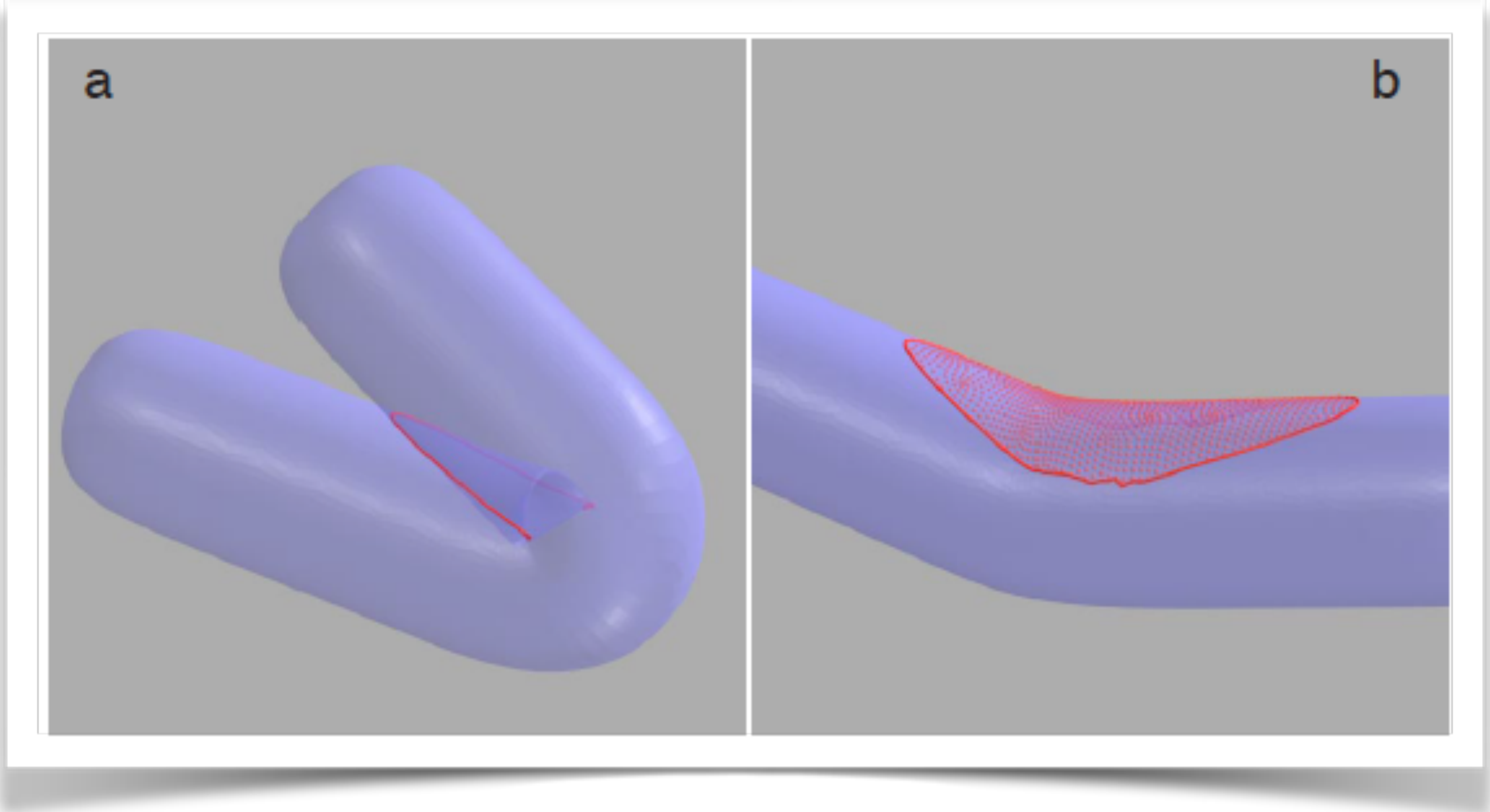
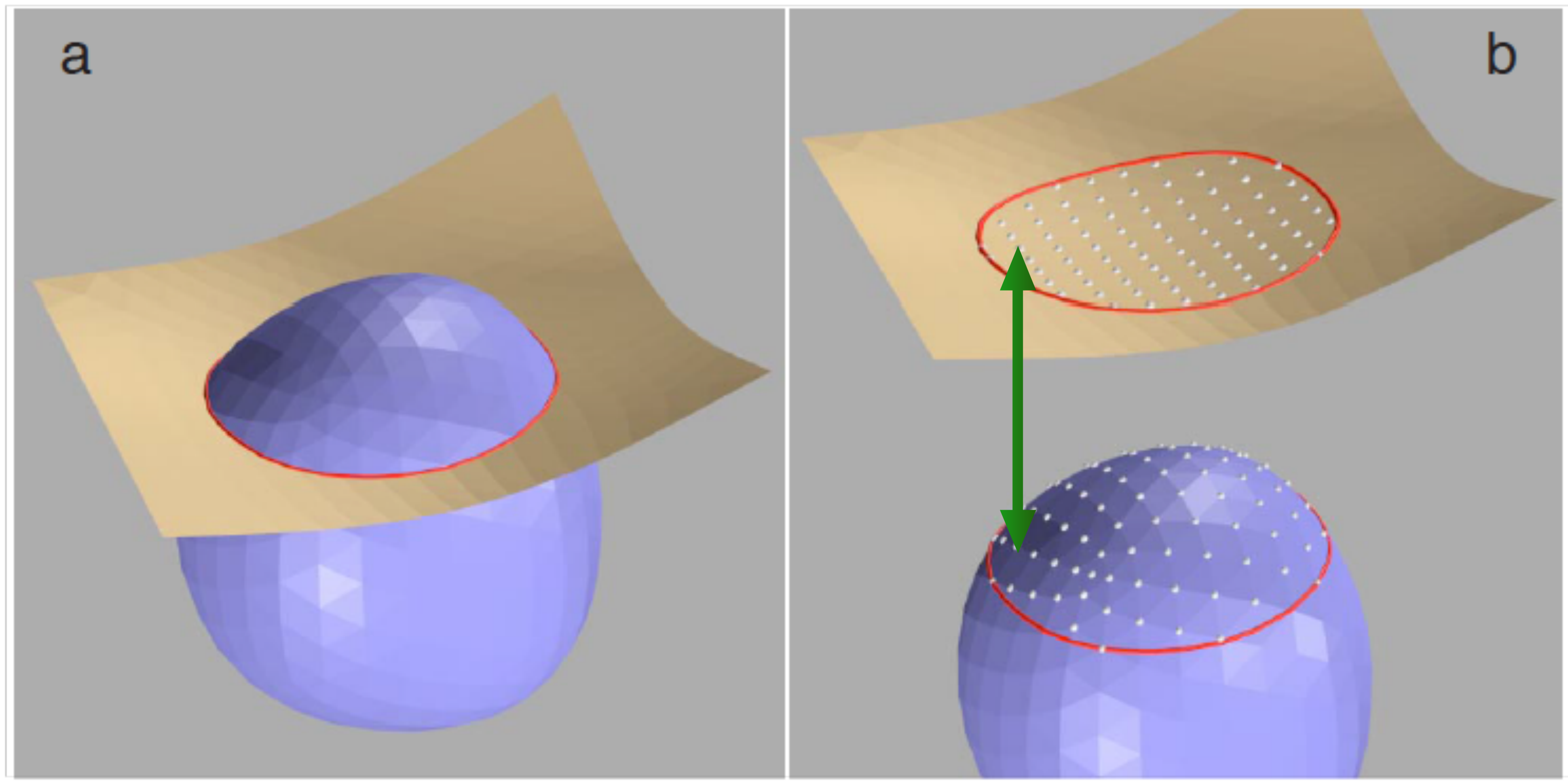


Special case:

- Sometimes intersections curves don't form a closed loop!
- … but by "rewinding" the model to its reference shape, a closed loop can be discovered! (still, this is the most challenging scenario)

Summarize the technical approach
(be intuitive; use math only if really necessary)

Approach

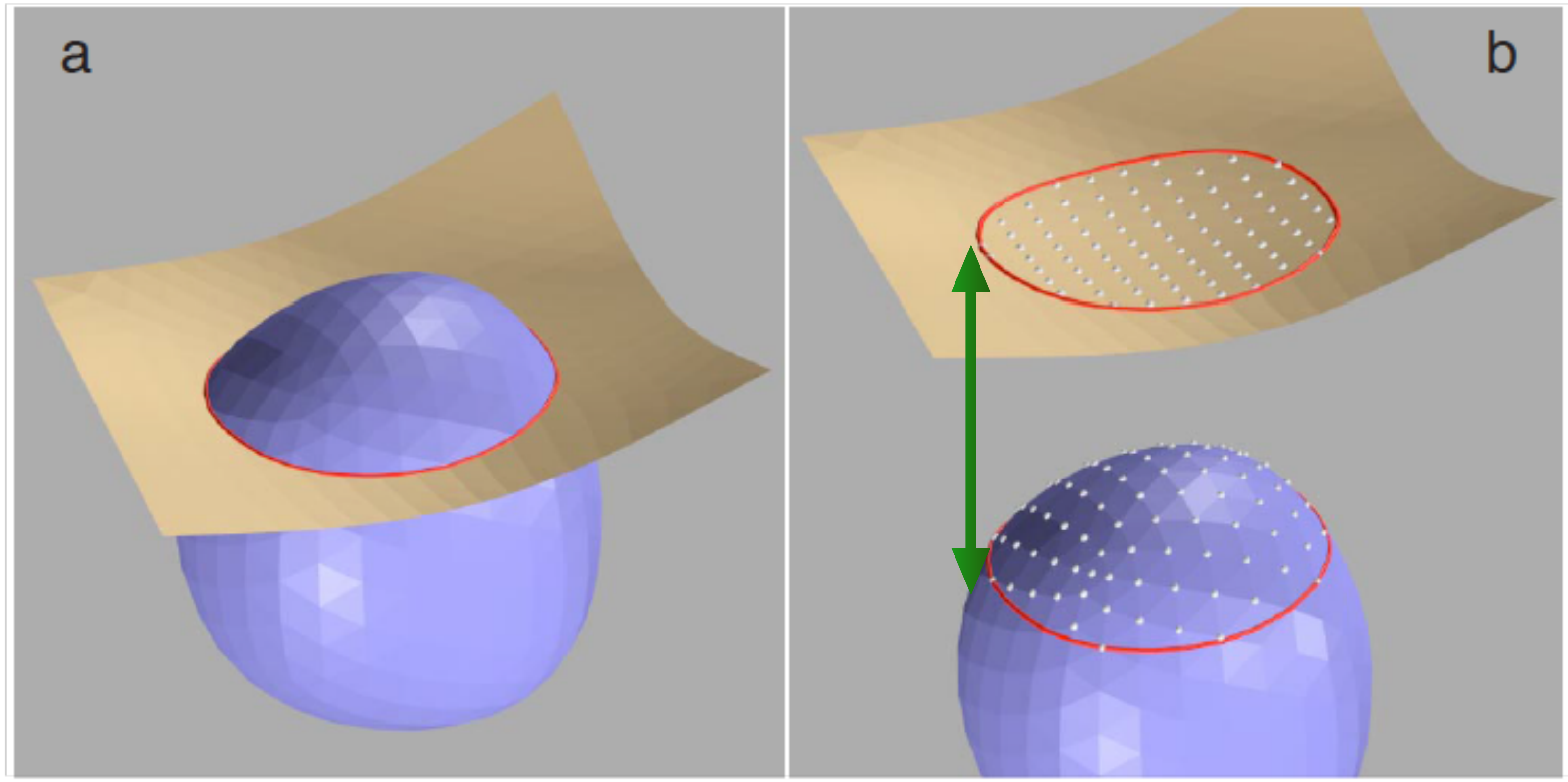


Response:

- Make "nearby" collided locations on different sides *attract* to one another (by a spring-like attraction force, built into the physics simulation)
- Goal : Encourage 2 sides to meet in the middle & reduce collision.

Summarize the technical approach
(be intuitive; use math only if really necessary)

Approach

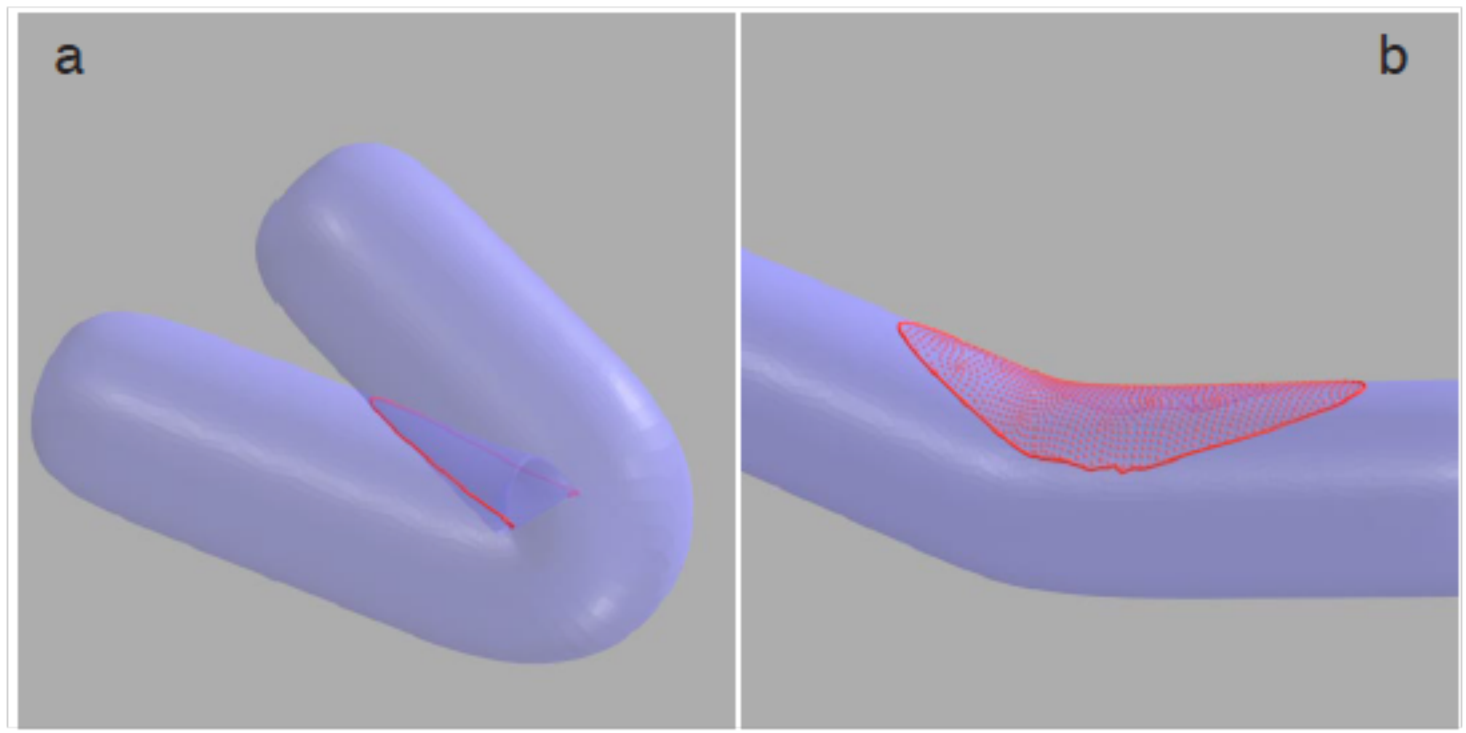


Response:

- Make "nearby" just-cleared locations on different sides *repel* one another (by a spring-like attraction force, built into the physics simulation)
- Goal : Discourage an imminent collision from happening anytime soon.

Summarize the technical approach
(be intuitive; use math only if really necessary)

Approach

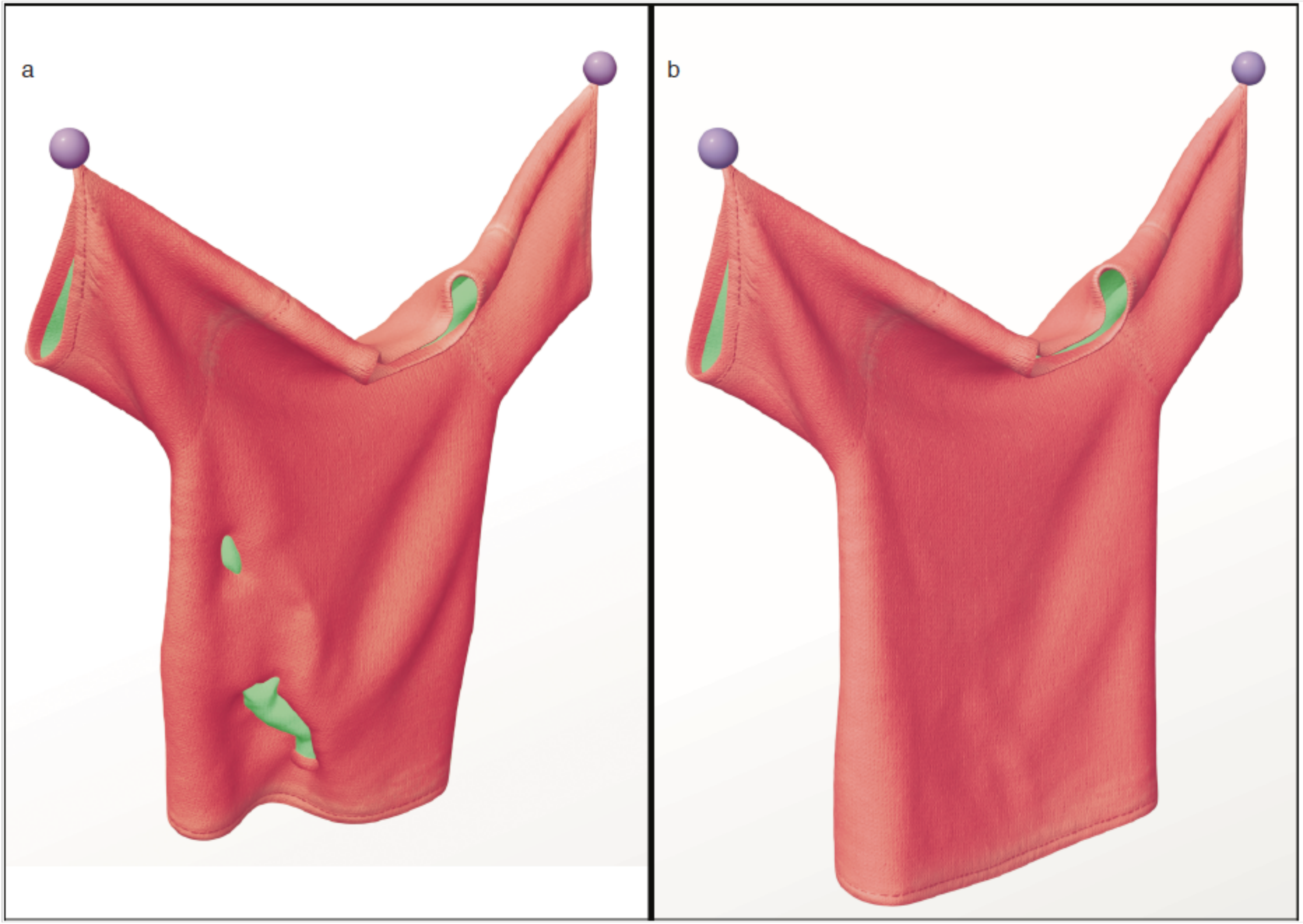


Response:

- Don't do anything for instances with "open" intersection curves
  (curves that were open prior to pulling them back)
- Difficult to define what "meeting in the middle means"
  (but we hope that the intersection won't be all that visible in such cases)

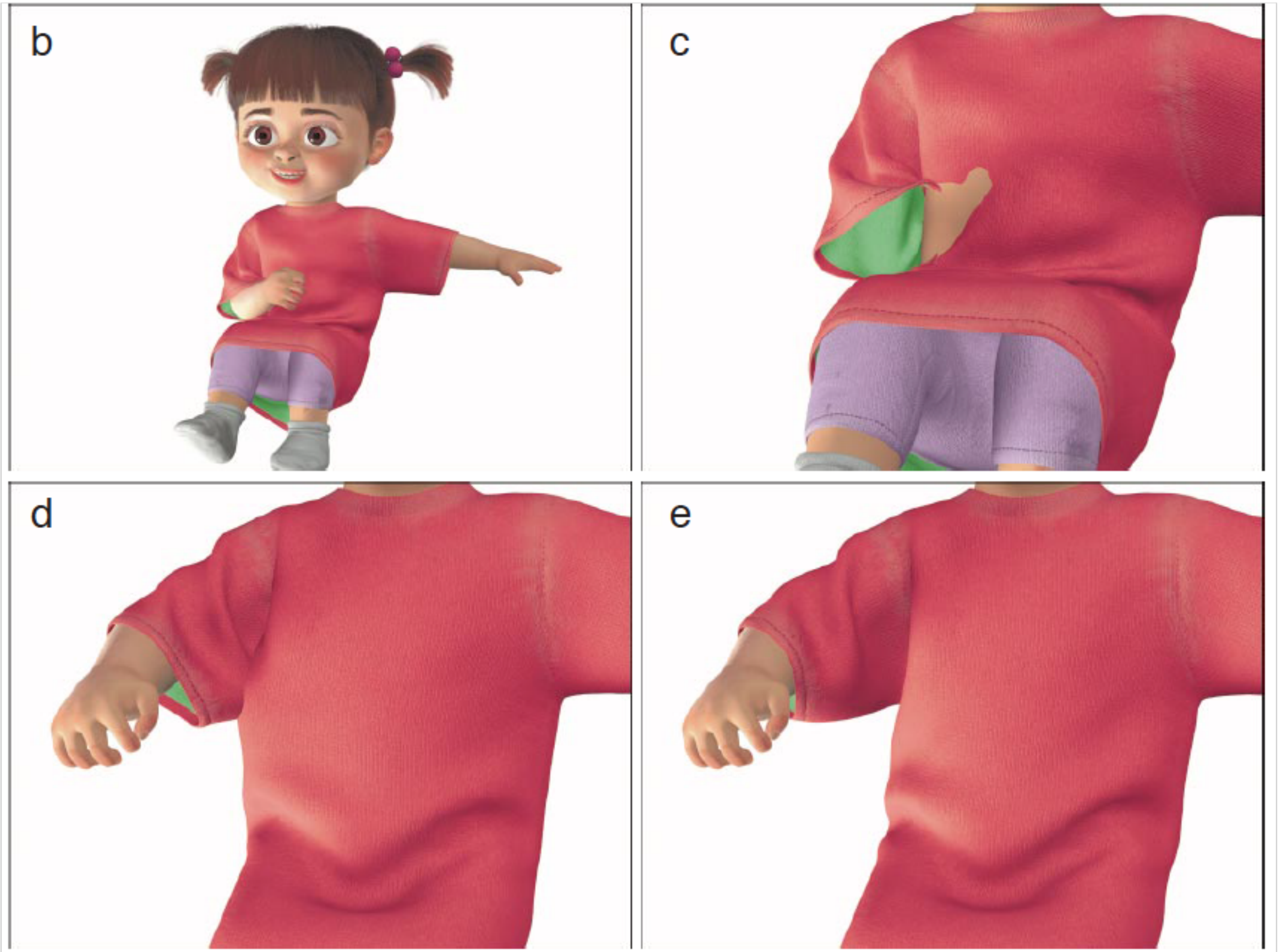
Summarize the technical approach
(be intuitive; use math only if really necessary)

Results



Show examples of the technique in action
(or performance numbers, if that is the goal)

Results



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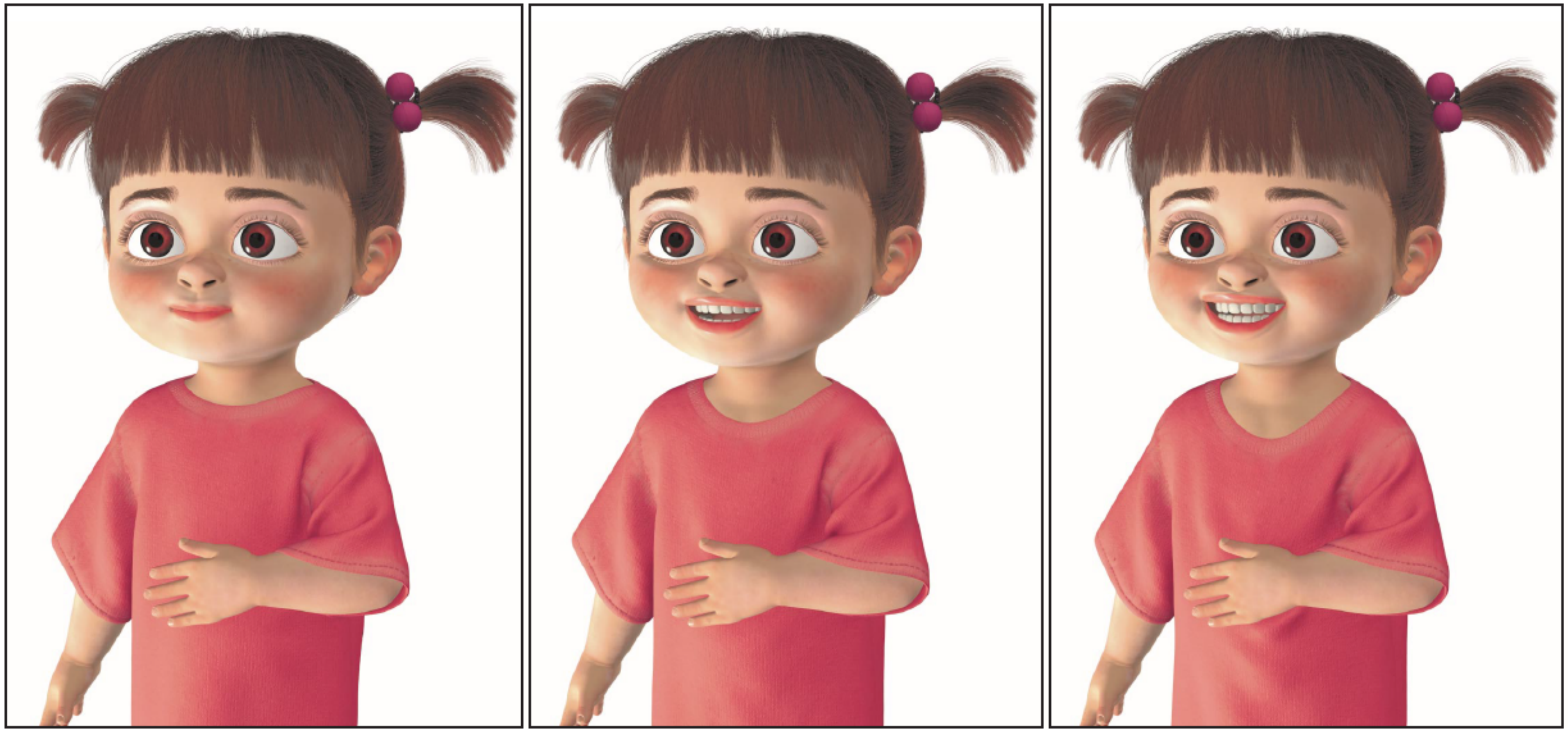

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done!

You may add (time permitting …)

- Follow-up work that you came across
- Critique (your own, or from papers read) of the strengths and weaknesses for the paper just presented
- Videos (when applicable)
- Discussion points you want to volunteer

Try avoiding …

- Too many equations, especially copied verbatim from paper
- Not discussing *why* we care about this paper
- Assuming that everyone knows as much about the paper as you do (it's ok to assume things already discussed in class)
- Dwelling in procedural implementation details (be careful … sometimes the implementation might be among the most interesting aspects of the proposed method)

Optional additions & things to avoid

Welcome to CS838!

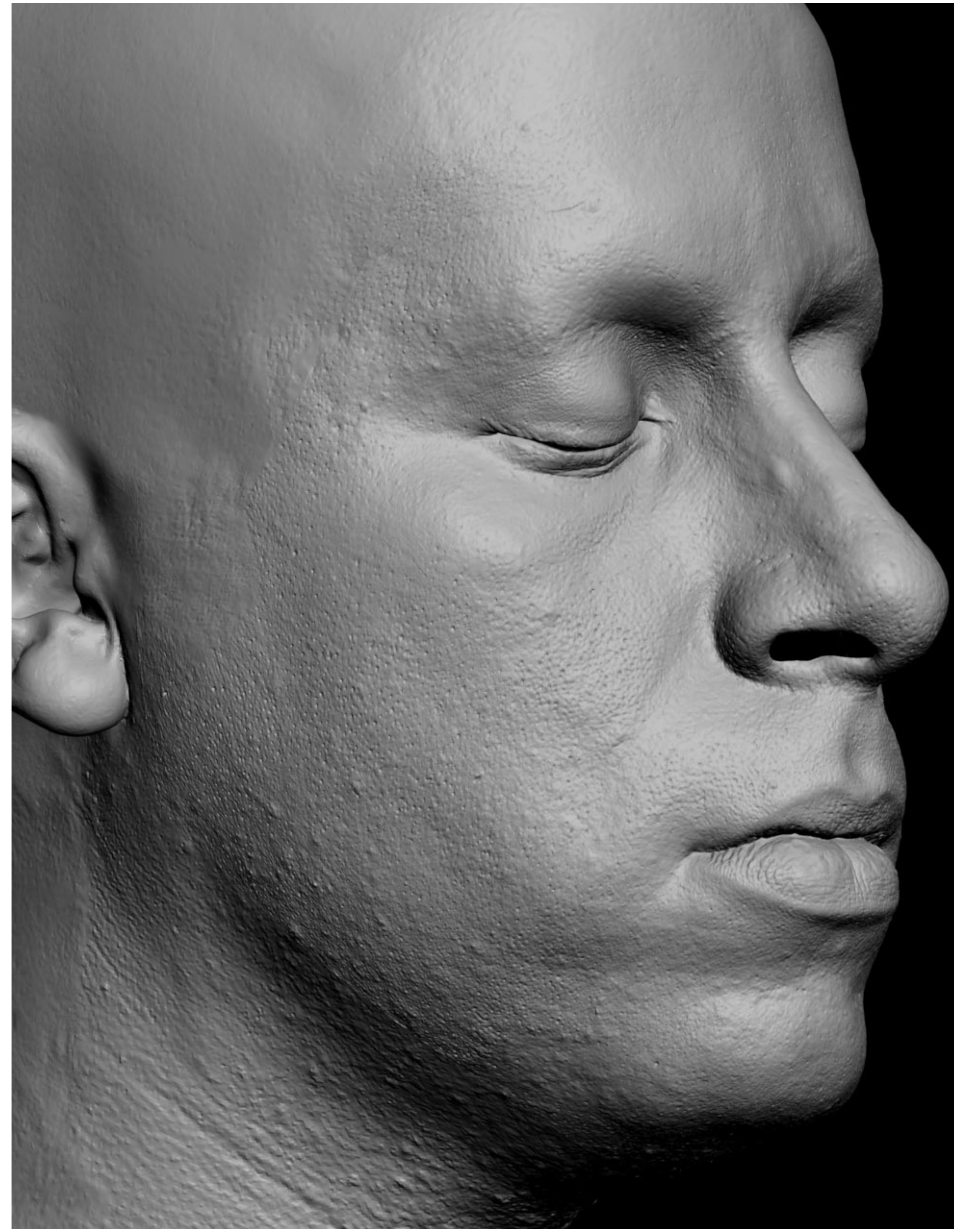
Topics In Computing: Advanced Computer Graphics

Fall 2015, 2:30-3:45 MW

About your instructor …

Research interests:

- Physics-based modeling
- Digital humans
- Simulated elastic objects
- Fluid animation
- Fracture & destruction
- Fast math in general



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