ACCELERATED CLOTH SIMULATION FOR VIRTUAL TRY- ON

Speaker: Tanya Amert

Host: Lori Pollock

CRA-W

Computing Research Association

Women

Speaker & Moderator

Tanya Amert

Tanya is currently a second-year Ph.D. student at the University of North Carolina at Chapel Hill in the department of Computer Science. She received her Bachelor of Science and Master of Engineering degrees from MIT, and then spent three years at Microsoft, working as a Software Engineer in Office 365. Her research focuses on physically-based simulations for VR applications such as virtual try-on.

Lori Pollock

Dr. Lori Pollock is a Professor in Computer and Information Sciences at University of Delaware. Her current research focuses on program analysis for building better software maintenance tools, software testing, energy-efficient software and computer science education. Dr. Pollock is an ACM Distinguished Scientist and was awarded the University of Delaware's Excellence in Teaching Award and the E.A. Trabant Award for Women's Equity.

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Accelerated Cloth Simulation for Virtual Try-On

Tanya Amert

CRA-W Virtual Undergrad Town Hall

July 14, 2016

About Me

- Education:
  - 2nd year Ph.D. student at UNC
    - Advisor: Dr. Ming C. Lin
  - B.S. and M.Eng. in EECS at MIT
- Work history:
  - Intern at Lincoln Laboratory for 2 summers
  - Intern at Microsoft for 1 summer
  - Software Development Engineer at Microsoft for 3 years

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

About Me

- What I research:
  - Physically-based simulations (like cloth!)
  - Especially accelerating them using GPUs or algorithm changes
- What my research requires:
  - Good programming skills, linear algebra, and lots of math
- How I got into this research:
  - Love of video games and movies for their graphics
  - Took a graphics class junior year
  - Did projects in my spare time while working
  - Took a graduate graphics class at UW
  - Applied to UNC and started last fall

Online Shopping is a BIG Industry

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Online Shopping is a BIG Industry

- Wouldn't it be nice to try on clothes before you buy them online?

- Next best thing: "virtual try-on"

Overview

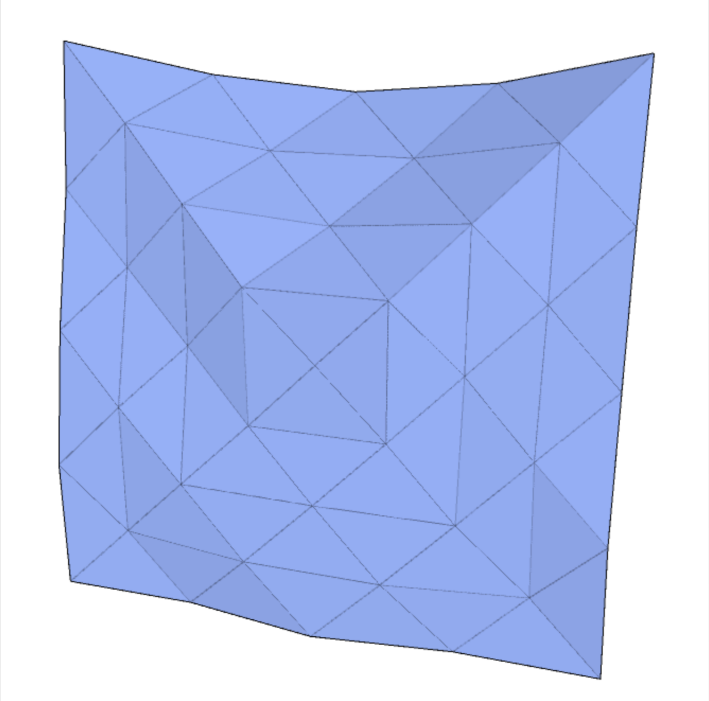
- Motivation

- How we simulate cloth
  - Cloth as a triangle mesh
  - Simulation framework

- Research challenges

How we simulate cloth

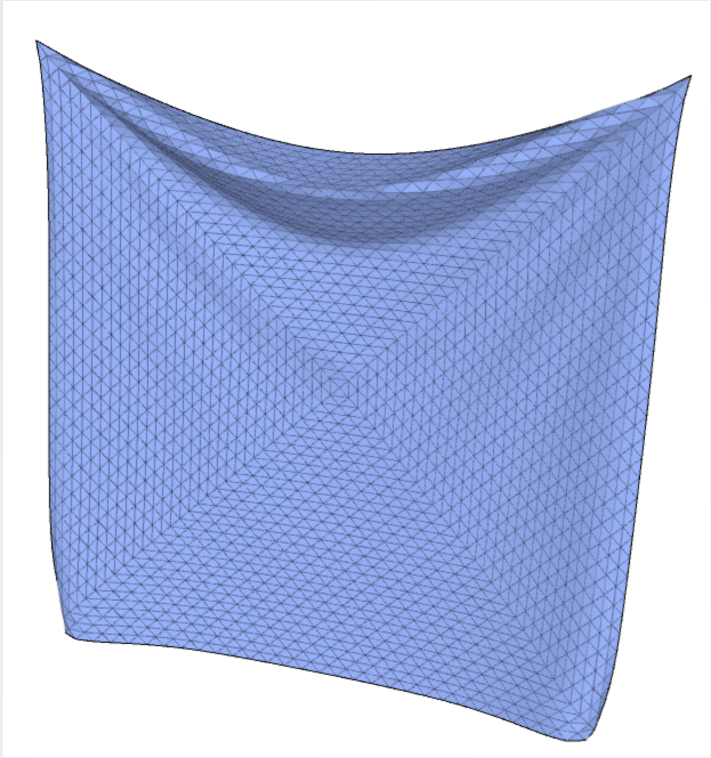
- Cloth represented as a triangle mesh



How we simulate cloth

- Cloth represented as a triangle mesh

- More/smaller triangles: more detail

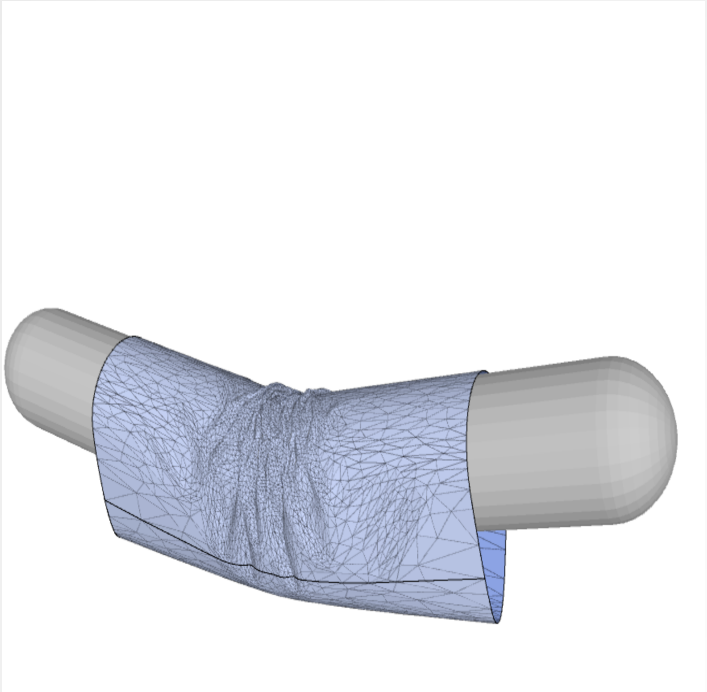


How we simulate cloth

- Cloth represented as a triangle mesh

- More/smaller triangles -> more detail

- Triangles don't all have to be the same size



How we simulate cloth

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- More/smaller triangles -> more detail
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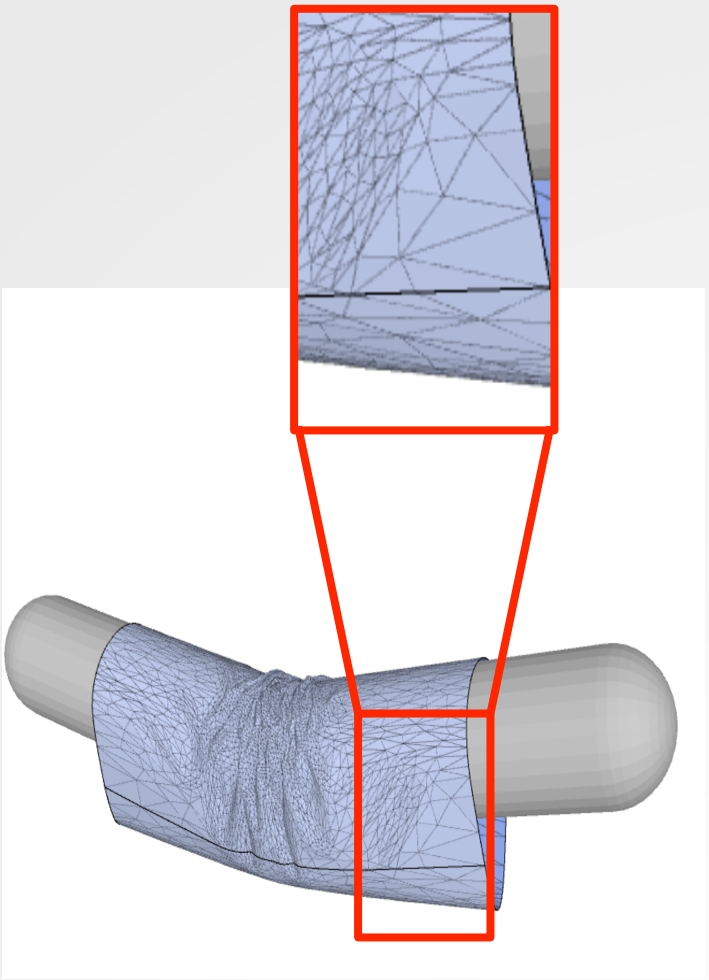
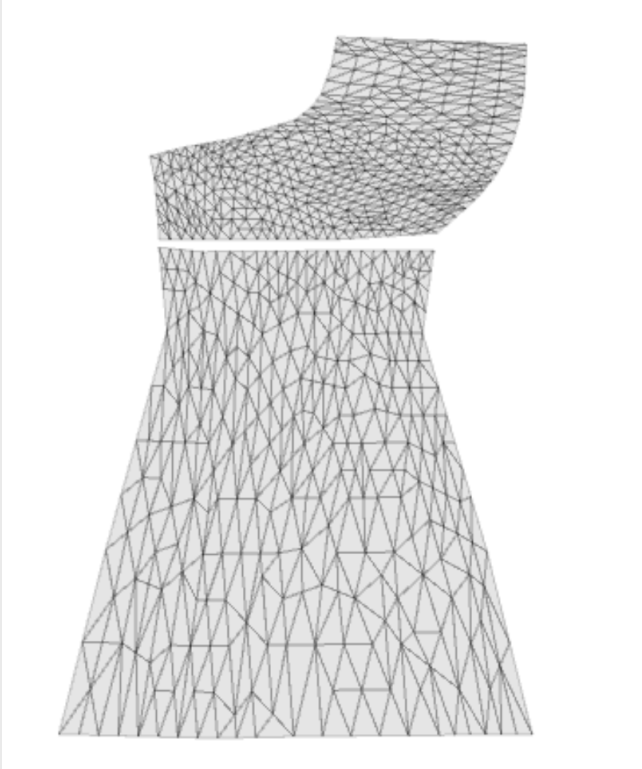
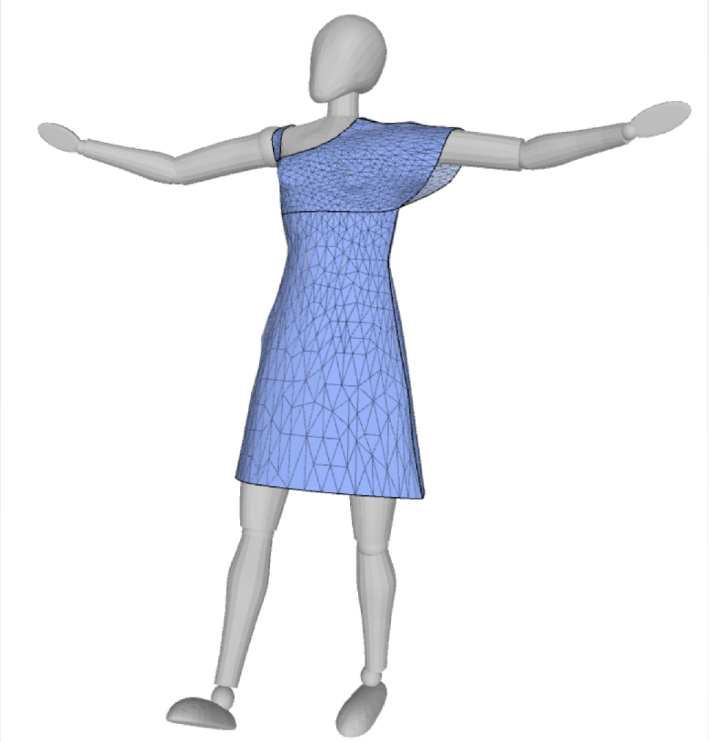


How we simulate *clothing*

A lot like sewing!



Combine panels at seams to make a garment.



Cloth simulation framework

- Cloth simulations are *physically-based simulations*
  - Simulate by stepping through time

- Each timestep:
  - Calculate forces
  - Update triangle positions
  - Resolve collisions

Cloth simulation framework

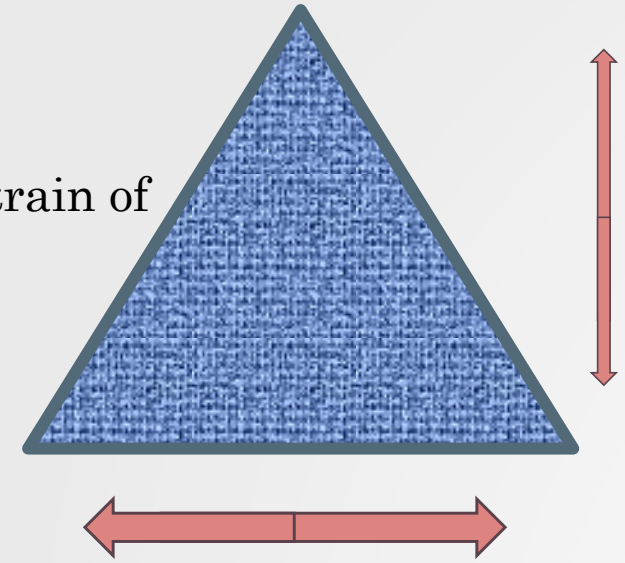
- Each timestep:
  - Calculate forces
  - Update triangle positions
  - Resolve collisions

- Forces act on each triangle face
  - External: gravity, drag, wind
  - Internal: bending (edges) and stretching (faces)

Cloth simulation framework

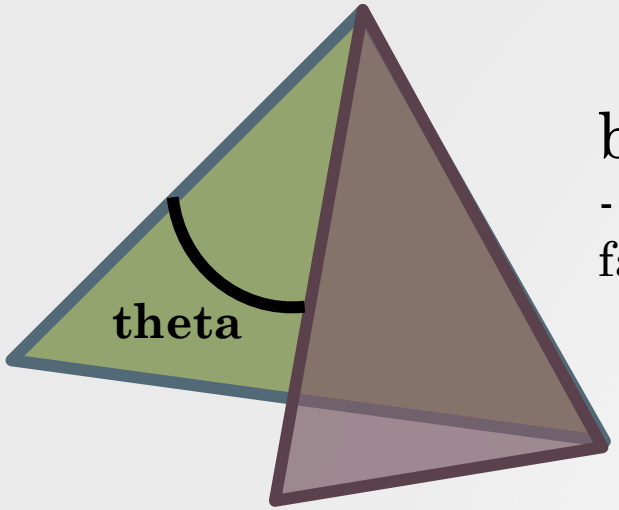
- Internal forces act as constraints on triangle faces (stretching) and edges (bending)

stretching
- based on stress/strain of material



Cloth simulation framework

- Internal forces act as constraints on triangle faces (stretching) and edges (bending)



bending
- based on angle between faces

Cloth simulation framework

- Each timestep:
  - Calculate forces
  - Update triangle positions
  - Resolve collisions

- Update the location of each vertex
  - Use $F = ma$, given previous forces, to get velocity:

$$v\downarrow new = a * dt = F * dt \,/\, m$$

$$x\downarrow new = x\downarrow old + v\downarrow new * dt$$

Cloth simulation framework

- Each timestep:
  - Calculate forces
  - Update triangle positions
  - Resolve collisions

- Types of collisions:
  - Cloth + obstacle
  - Cloth with itself (self-collision)

Overview

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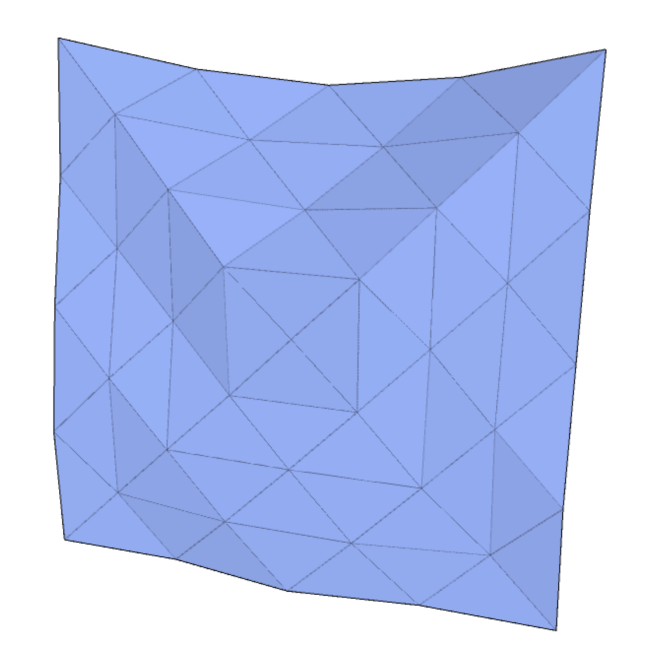
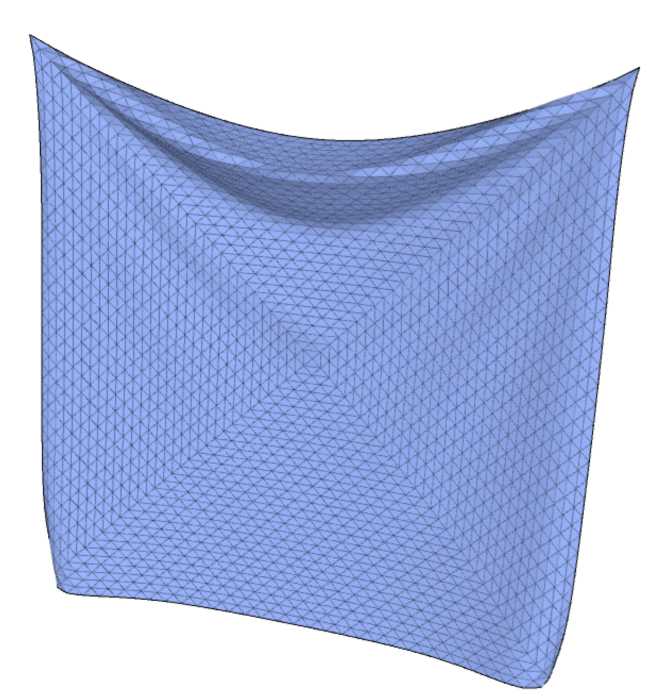
Challenge #1

- More triangles -> more details, but slower



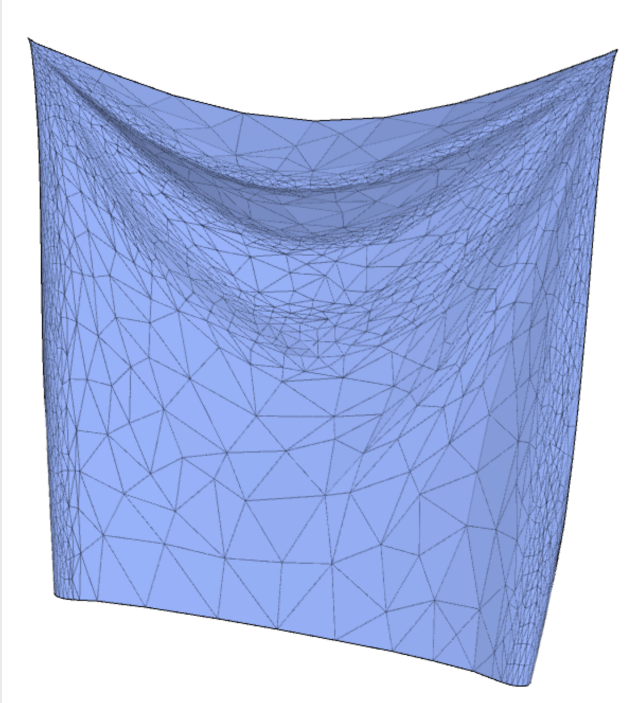
64 triangles



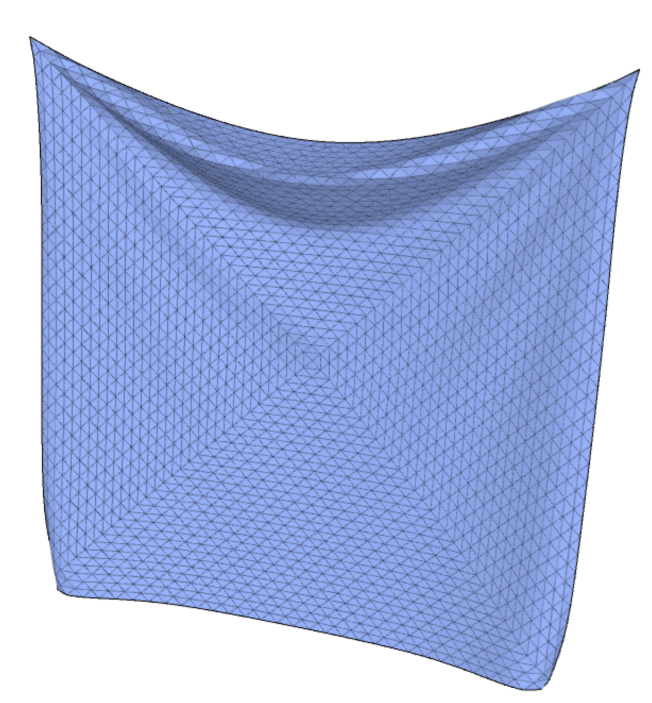
4096 triangles

Possible solution

- Adaptive remeshing [Narain et al. 2012]
  - Only have small triangles where detail is needed



adaptively-refined triangles



4096 uniform triangles

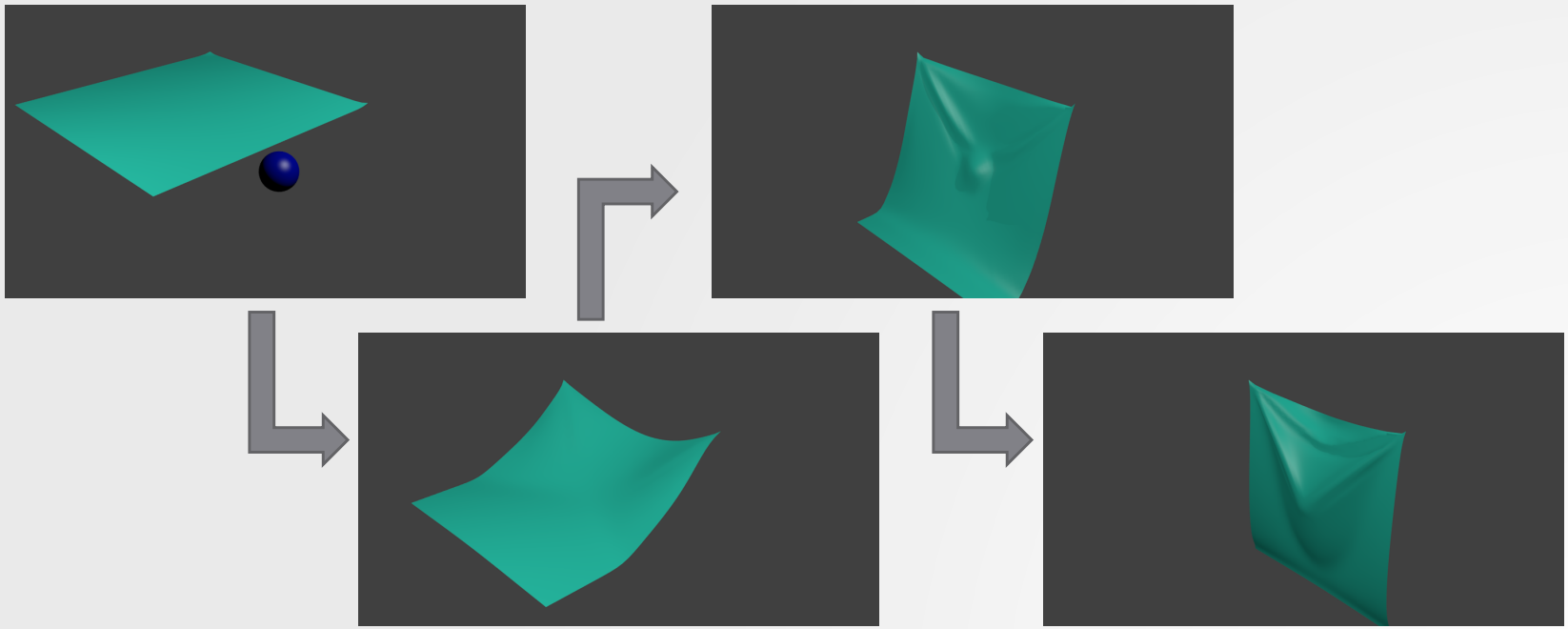
Challenge #2

- Cloth simulations are time-dependent: each frame depends on the previous

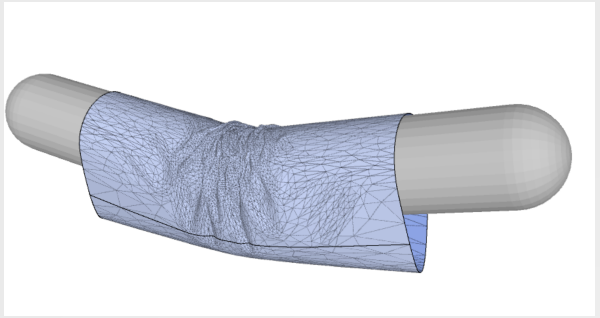
$$x\downarrow new = x\downarrow old + v\downarrow new * dt$$

Challenge #2

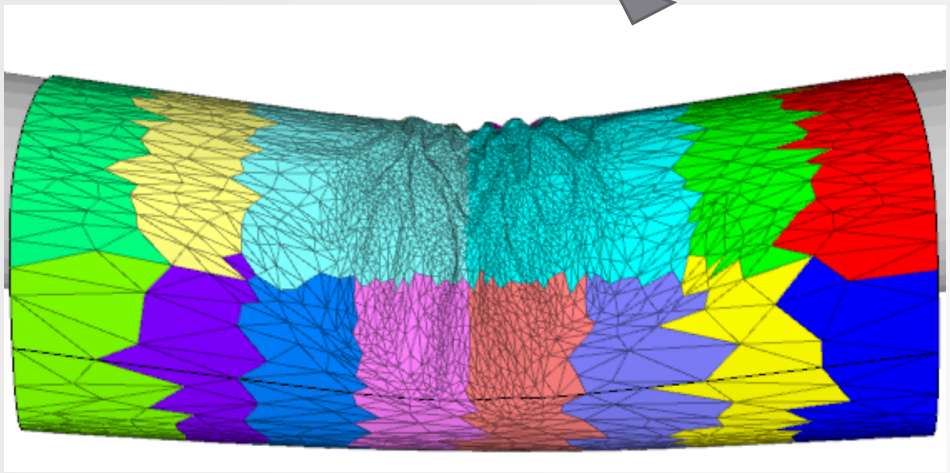
- Cloth simulations are time-dependent: each frame depends on the previous



Possible solution



- Distribute the cloth simulation
  - Typical approach: divide up mesh
  - [e.g. Thomaszewski et al. 2007]



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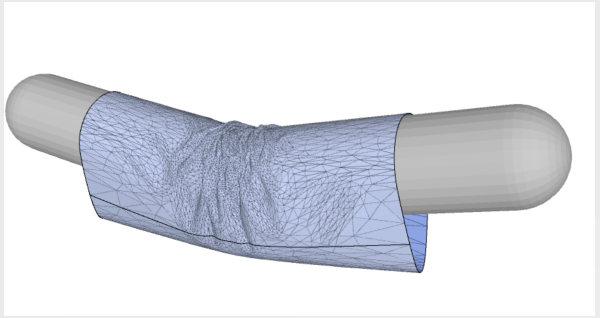

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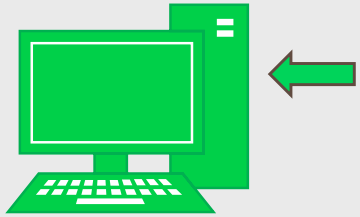

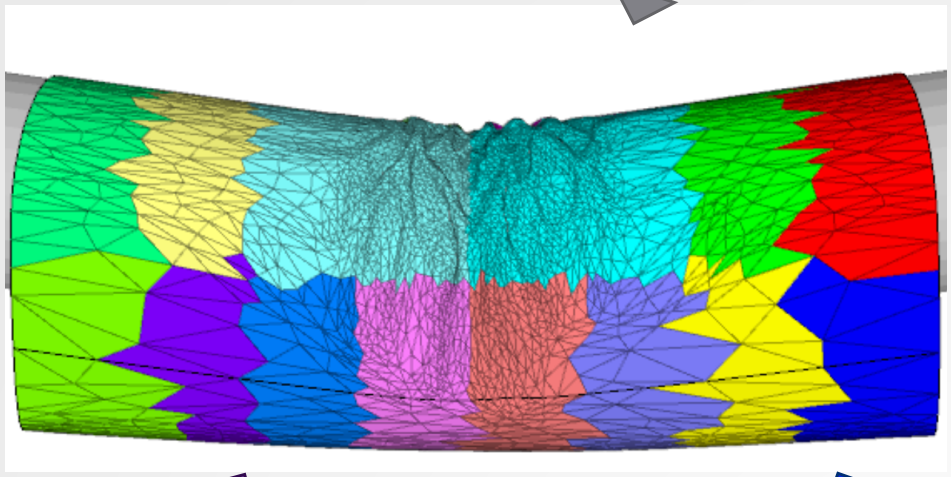

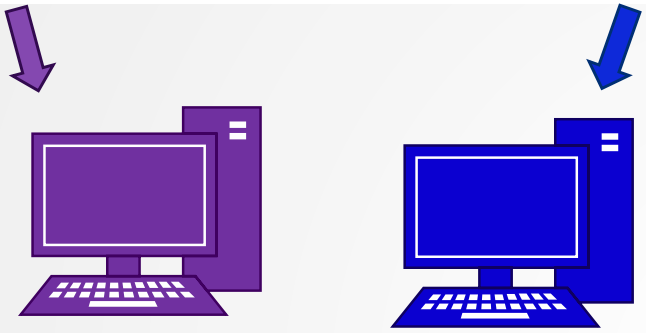

  - [e.g. Thomaszewski et al. 2007]

Future work

- What if we could divide up the work over *time*?
  - Each machine simulates the entire mesh for a slice of the frames

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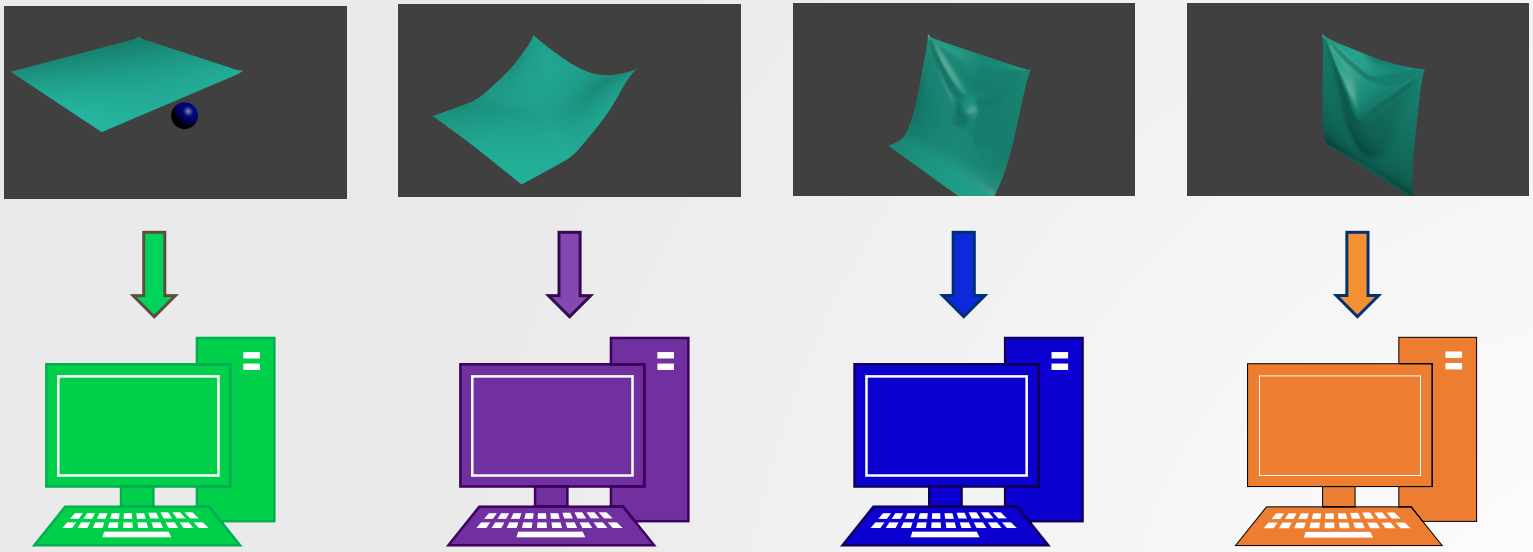

Summary

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- How we simulate cloth
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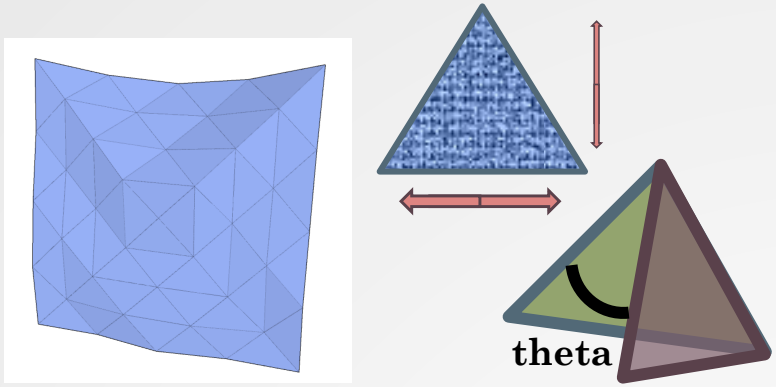
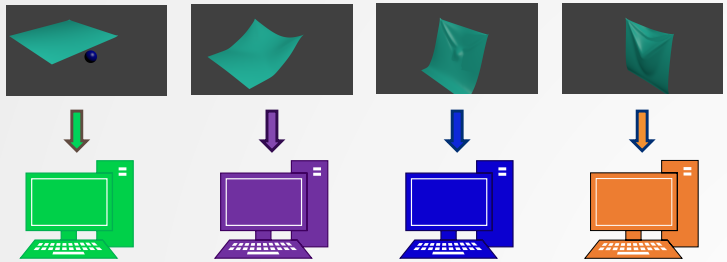


- Research challenges
  - Working on a research paper submission!



Grad School Applications 101

Tanya Amert

CRA-W Virtual Undergrad Town Hall

July 14, 2016

Why Graduate School?

- To solve the current problems on the frontier of computing
- Lead/collaborate with smart people in important research problems in a **company** or **national lab**
- Travel to international conferences to share your research and network with other researchers around the world
- To get a higher starting salary
- To be a professor

- *For me*:
  - I want to work on cutting-edge graphics problems
  - It opens more doors than it closes

Grad School Applications 101

- Why should you consider grad school?
- What are all the parts of an application?
- What does the timeline look like?
- Which schools should you apply to?
- How does graduate school compare to industry?

Application Materials

- Most schools want these materials:
  - Application // contact info, education info, etc.
  - Transcripts // the real ones, so make sure you do this early!
  - Letters of recommendation // usually 2-3
  - Statement of purpose // your research goals, why their school
  - Resume or CV // your work and research experience
  - Test scores // GRE, maybe GRE subject tests, TOEFL/IELTS
  - Fee // $$

Application Materials: transcripts

- Most schools want one official transcript
  - But some want two!
- Make sure you send these right away to any schools you know you're applying to – they can have delays, especially if physically mailed and sorted
- If you changed your name (e.g. after getting married), this is even more work for them
  - Send a thank-you email if you verify that they've received it

Application Materials: LoRs

- You probably want at least 2 professors as letter writers
  - Preferably at least one you've done research with
  - One professor once told me: give your letter writer a rough starting point, including your career/research goals, transcript, statement of purpose, etc., so that they can make it more personal and real

- Most importantly: ask them "Are you able to write me a **strong** letter of recommendation?"
  - Give them an out – a great letter from your second choice is better than a neutral letter from your first choice writer

Application Materials: SoP

- Make it memorable, but not just a life story
- Clearly state why you feel like their program is the best for your academic and career goals
- Also describe how you will contribute to their program
  - Make them want you!
- You should tailor the SoP to each school (really, each lab you're interested in)
  - Mention specific professors whose research you're interested in
  - Do not just copy-paste

Application Materials: tests

- It's never too early to start studying
  - You can send your GRE scores to up to 4 schools plus your undergrad for free, but each school after that costs money
  - You can use your GRE scores for up to 5 years

- If you are not a native English speaker, you might need to take additional exams
  - E.g. TOEFL, TOEIC

Grad School Application Timeline

- Start: no time like the present!
  - GREs and talking to letter writers can be done well in advance
  - You can also start thinking about where to apply – now is a great time of year!
- Applications usually open in early fall
  - In my experience, often mid-September
- They close around Christmas
  - For me, about December 10th-15th
- Decisions are in February-March, visits in March-April
  - I had to decide by April 15th

Where to apply?

- It's not just about rank:
  - Highly-ranked programs might not be doing research you're interested in
    - Fit matters!
  - Seek out advisors and research you like
    - My current advisor listed her collaborators on her website, which turned out to be a great list of places to apply ;)
- Advice: find papers you like on Google Scholar, and look at collaborators!

Grad school vs. industry

Grad School

- Less money
- Not too hard to transition to industry
- Flexibility in what you work on
  - Depending on your advisor
- Free time is time to spend reading more papers

Industry

- More money
- Golden handcuffs – it's hard to leave industry for grad school, and hard to break into academia once you leave it
- Your work is determined by the company's needs
  - And also what your program managers prioritize…
- All the free time – work-life balance

Transition from industry

- It takes time to get back into the “school” mindset
- Living like a student while working makes it easier
  - Adjust spending habits // less eating out
  - Spend evenings studying, too // not just video games
  - Start reading papers // ask your advisor for suggestions
- Taking a little time off really helps!
  - I had a break of about six weeks to move and mentally reset

Resources

Visit **CRA-W.org** for more resources for all levels of your career

Join our CRA-W mailing list, **CRA-W Updates**, by going to bit.ly/1McQCDd

Follow @CRAWomen to find out about upcoming events or programs

Don’t forget to take the feedback survey!

PLEASE TAKE FEEDBACK SURVEY : http://bit.ly/1MgGnIG