Major unmet need for knee prostheses in India

- 200,000 above-knee amputees in India [1]
- Over 40% of them live < $1.25/day [2]
- Unemployed and suffer severe personal and societal consequences [2]
- Metabolically inefficient by up to 70% [3]

1. Narang 1982
2. Hamner 2013
3. Andrysek 2010

3

Problem

Motivation

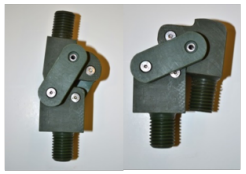
Prior Art

Research Objectives

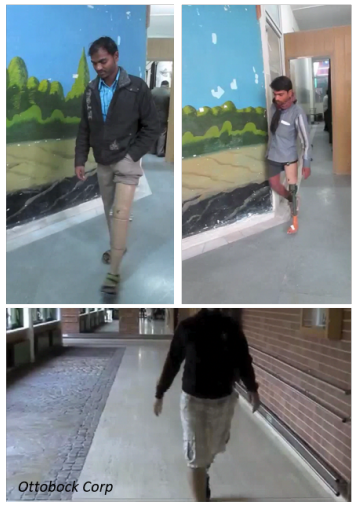
Cost vs. Performance gap for passive knees

Jaipur Exoskeleton knee $10

Jaipur-Stanford 4 bar knee $25



Active knees ~ $10,000-60,000



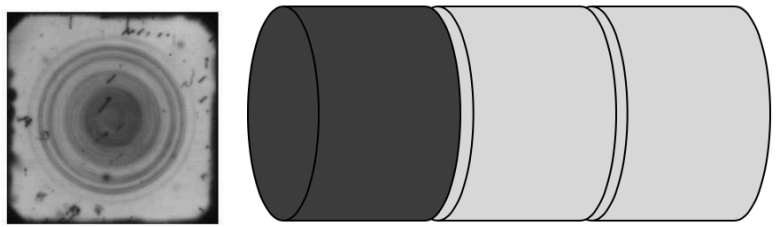
Lower-cost, higher performance Knee[1] $100-150

1. In review, 2015: Narang, Y. S., **Arelekatti, V. N. M.**, Austin-Breneman, J. & Winter, A. G. (2015). Using Human-Centered and Biomechanical Analysis to Determine Design Requirements for a Prosthetic Knee for Use in India

4

Oxygen affects yield

- Efficiency loss: 5-20% relative drop
- Manufacturing yield loss: 25% - 30% of single crystal Si wafers



6

Research Questions

1. When all oxygen precipitates dissolve, how much efficiency can be recovered?
2. What is the limiting physical process (energy barrier) when dissolving the precipitates?
3. When does high temperature annealing to dissolve oxygen precipitates work?

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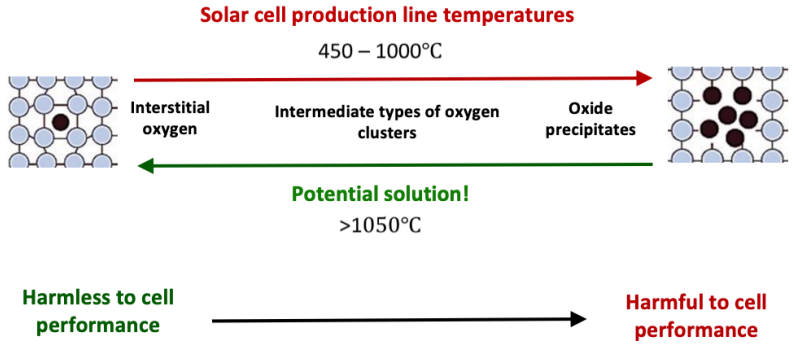
Motivation

Problem

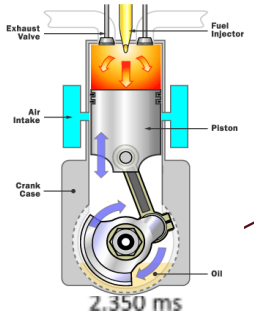
Research Objectives

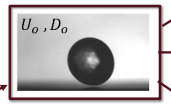
Oxygen defects change during processing



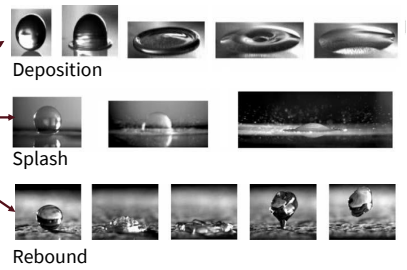
9

Fuel drop impact phenomenon: Why is it important?





Few possible outcomes of fuel drop impact



- Fuel spray impact morphology on the hot walls of the combustion chamber influences engine performance and emissions
- Fuel spray impact in engine combustors can be understood by breaking down the problem into single drop impacts

Factors influencing drop spreading phenomenon:
- Droplet diameter
- Distance between nozzle tip and surface
- Properties of the impinging fuel
- Surface temperature
- Surface morphology

Viverjita U., *MSc (Engg) Thesis*, IISc (2017)
Rioboo et.al, *Exp. in Fluids*, 33 (2002)
Zhao et al., *SAE Int. J. Fuels Lubr.* 10 (2017)

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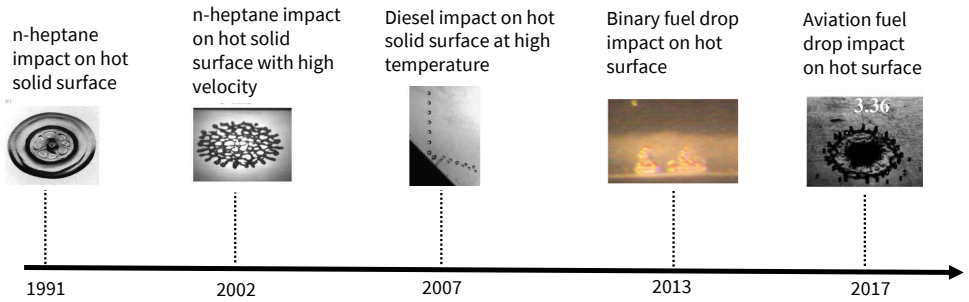
Literature review of fuel drop impact on heated surfaces



Literature review indicates most work on fuel drop impact on hot surface is focused on
- Understanding drop impact of a single fuel
- Surface temperatures either below or above boiling point

A comprehensive understanding of the effect of surface temperature and fuel properties on the drop spreading process is yet to be obtained

Chandra and Avedisian, Proc. R. Soc. Lond. A, 432 (1991)
Manzello and Yang, *IJHMT*, 45 (2002)
Chen et al., *ETFS*, 32 (2007)
Kompinsky et al., *CES*, 98 (2013)
Sen et al., *Int. J. Thermal Sci.* 121 (2017)

5

Motivation

Problem

Research Objectives

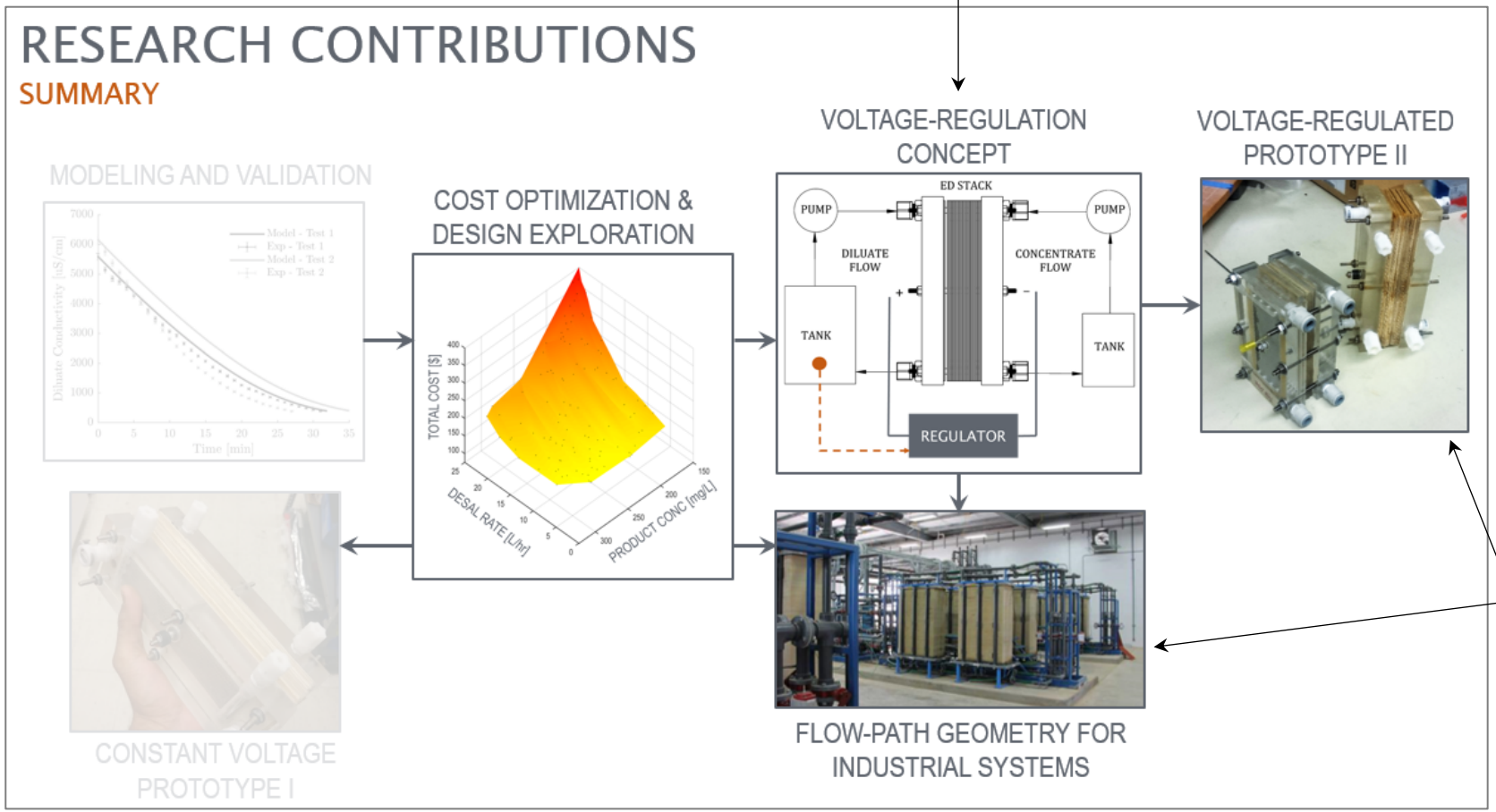
Objectives of the present work

- **To study the effect of surface temperature on the fuel drop spreading process**
- **To study the effect of fuel properties on the fuel drop spreading process**
- **To evolve a detailed understanding of the single fuel drop spreading process on a hot substrate that can be used for studying fuel spray impact processes in engines**

6

Roadmap Example 1:

Highlights the 'creative' solution

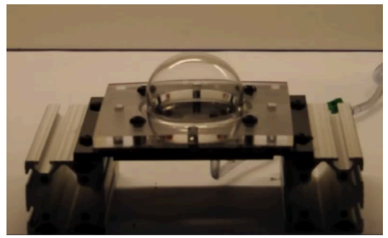


Scopes the presentation while mentioning other work

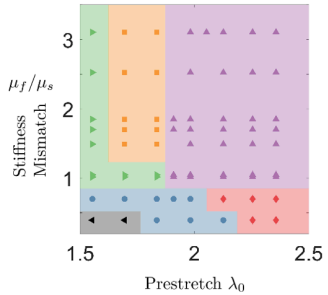
Features outcomes

Roadmap example

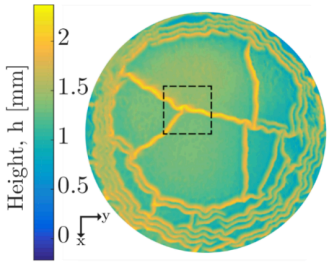
Outline



Developed novel experimental design to study bilayer buckling



Explored buckling pattern parameter space



Characterized propagation of ridge buckling mode

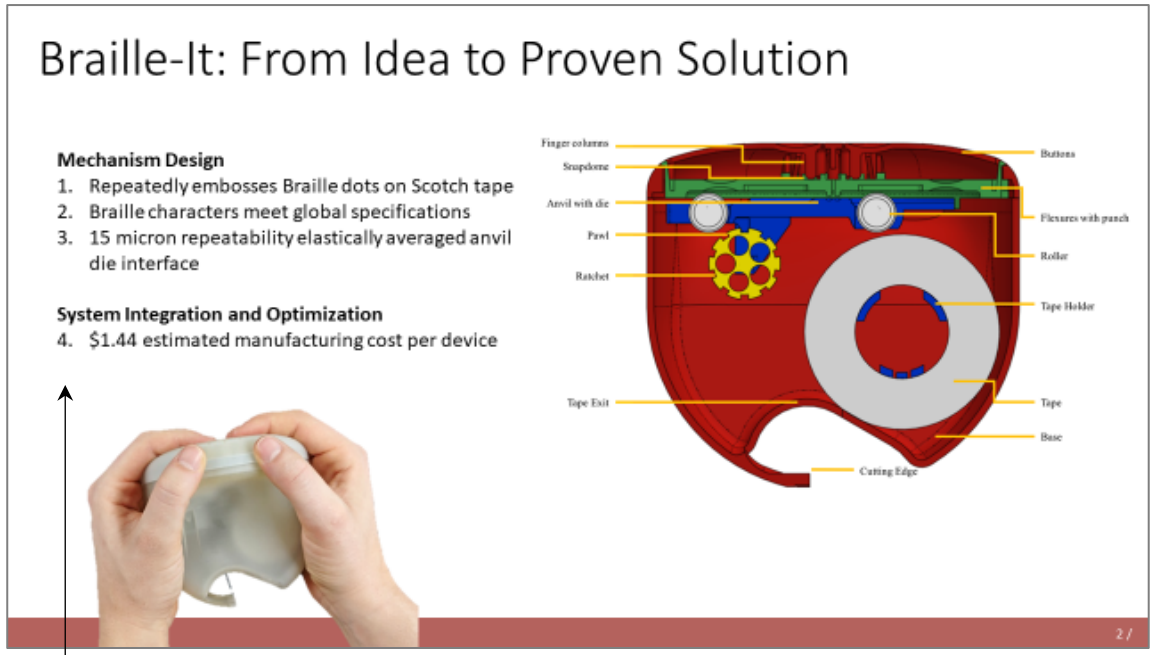
Publication: Al-Rashed et al, *Soft Matter* (2017).

4

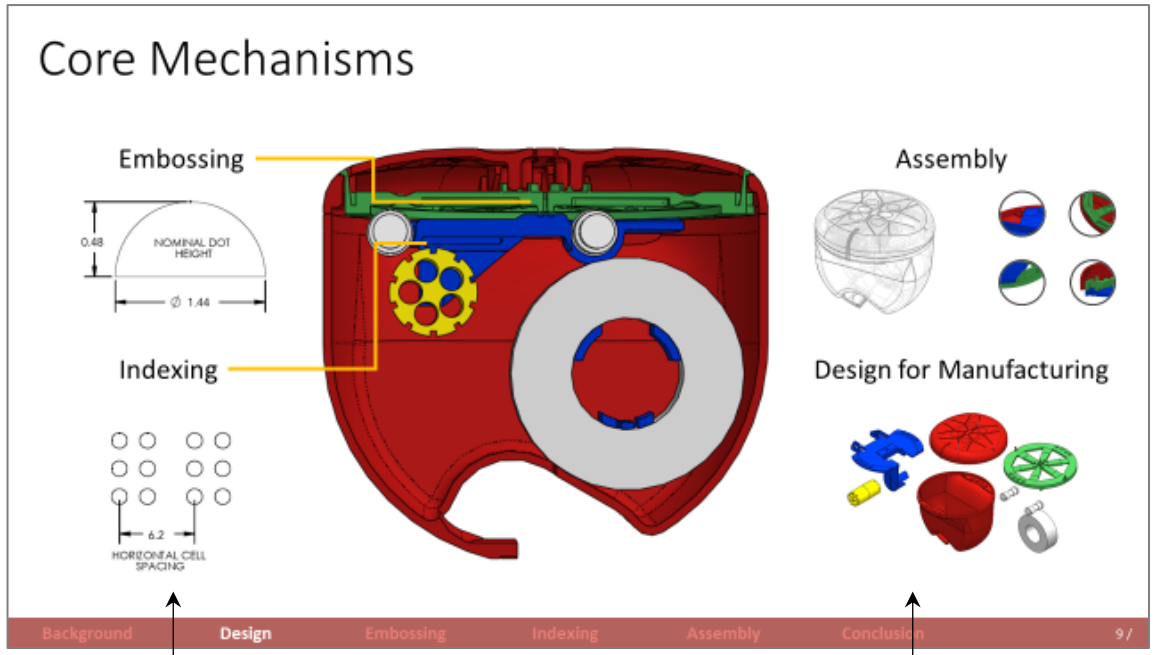
- States contributions beforehand, so audience knows where the story is going (no mystery story!)
- Introduces key images that will come back

Roadmap Example 2:

RESEARCH OUTCOMES



APPROACH



Enumerates key outcomes succinctly

Calls out four specific areas researcher will address later; gives broad, visual overviews of them

Roadmap Example 3:

Current work is motivated by the state of the field

Visuals repeated throughout the presentation

Problem statement:

Despite 10 years of research, no Indian homes use electrodialysis.

Research Questions:

1. Have we identified all the customer needs?
2. What opportunities exist for designing a new point-of-use ED system?
3. How can we compare system concepts?
4. Is there an ED concept that meets all the requirements?

4

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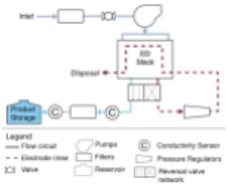
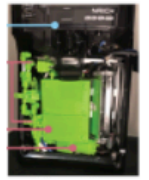
Scope and main contributions

Needs	Concept generation	Simulations	Proof of concept
			
Elucidated unmet integration needs from manufacturers	Invented new system concept for small scale ED	Demonstrated the novel concept better meets the market needs than previous concepts.	

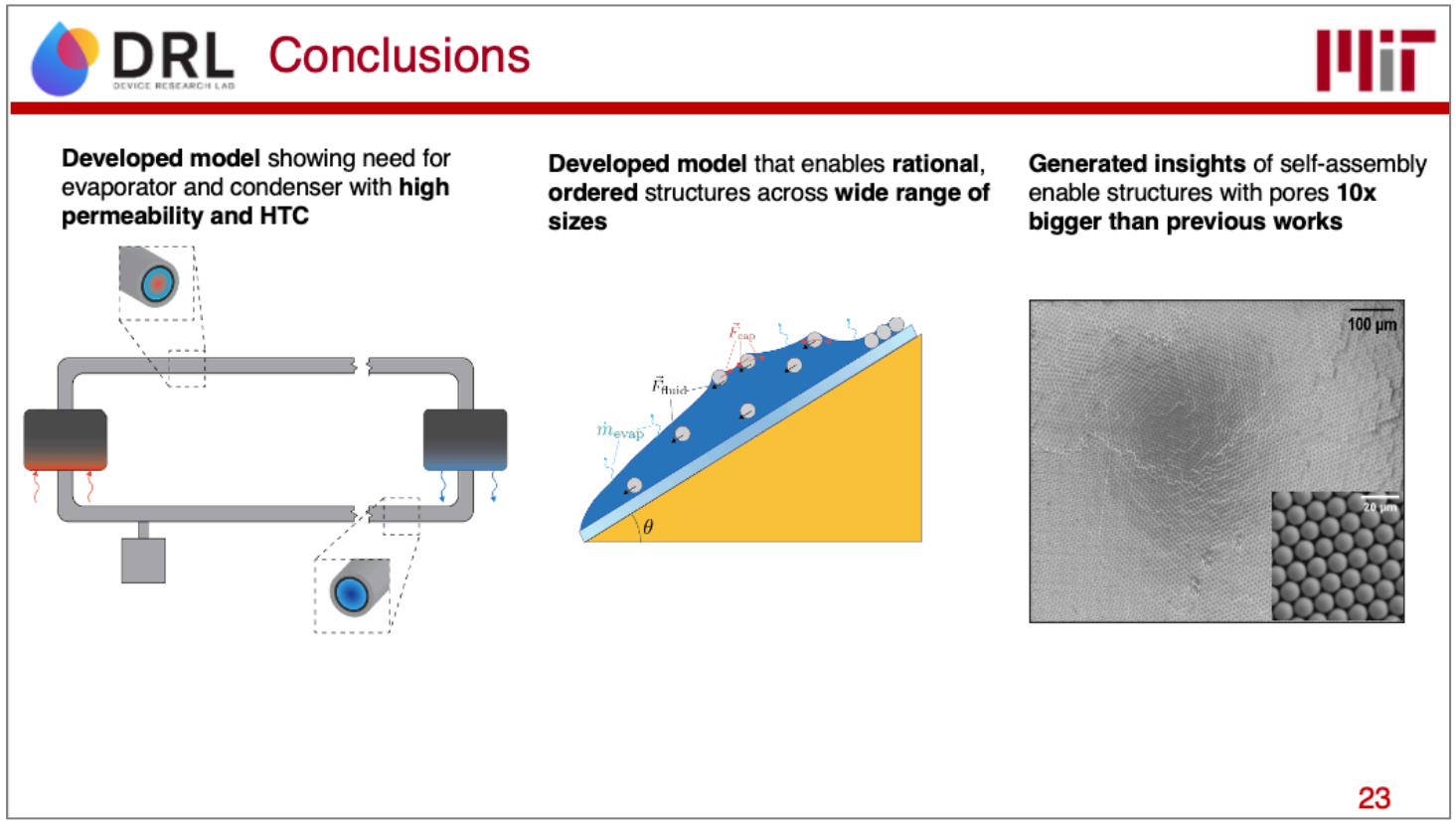
H. Varner, S.R. Shah, A.G. Winter, U.S. "Simplified Architecture for Desalination via Electrodialysis." *Patent application serial number 63/065,574.*
H. Varner, S.R. Shah, and A.G. Winter. "The determination of a cost optimal design for a multiple stage continuous electrodialysis desalination device for use in domestic point of use water purification." *International Design Engineering Technical Conferences & Computers and Information in Engineering Conference*, pages 1–8, St. Louis, 2020. ASME
H. Varner, S R. Shah, and A G. Winter. "Architecture and unit design of a capital cost optimized, household electrodialysis desalination device with continuous flow." *In preparation.*

5

Contributions highlighted

Hannah Varner. Product Design RQE, Jan 2021.

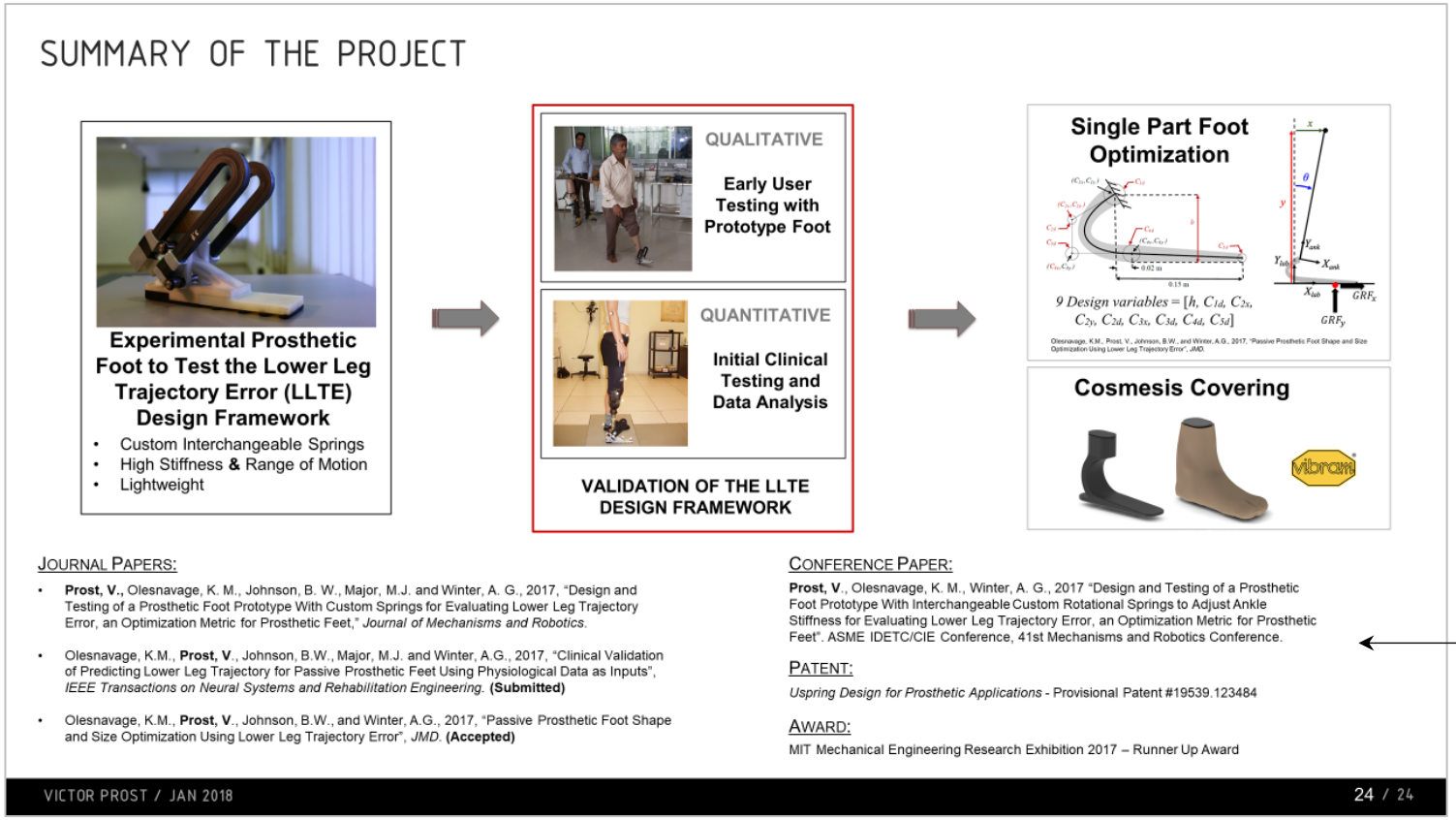
Close the loop with conclusions before discussing future work



- Summarizes work
- Jogs audience memory
- Prompts questions
- Emphasizes new contributions to the field

Use final slide to reiterate your contributions

Instead of asking “Questions?”, try…



- Summarizes work
- Jogs audience memory
- Prompts questions
- Emphasizes new contributions to the field

Lets you highlight publications, patents, and/or awards

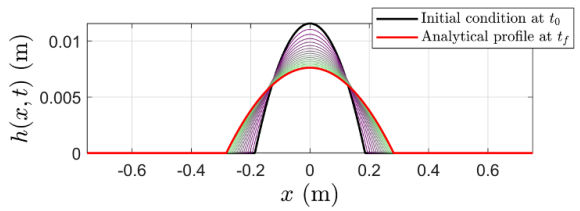
Victor Prost. Machine Design RQE, Jan 2018.

Use final slide to reiterate your contributions

Instead of asking “Questions?”, try…

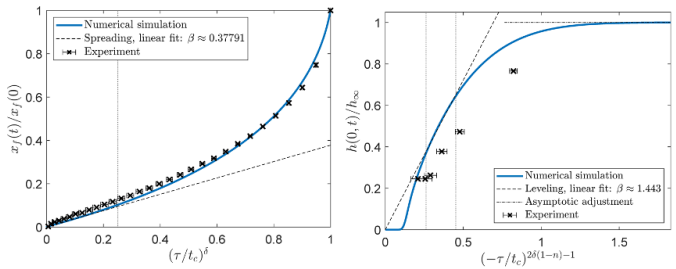
Contributions

Novel numerical scheme derived:



- 2nd order accuracy.
- Respect mass conservation on discrete level.
- Captures spreading and levelling.
- Can simulate wider variety of problems (rheology, geometry, porous media).

2nd kind self-similar problem:



- Simulations show good agreement with experiments and analytical solution.
- Quantified ‘adjustment’ time for self-similarity to begin.
- Validated levelling self-similarity rigorously.

Publications:
[1] **Ghodgaonkar A.A.**, Christov I.C. (2019) Solving Nonlinear Parabolic Equations by a Strongly Implicit Finite Difference Scheme In: Applied Wave Mathematics II. Mathematics of Planet Earth, vol 6. Springer. (link)
[2] Zheng Z., **Ghodgaonkar A.A.**, Christov I.C. Shape of spreading and leveling gravity currents in a Hele-Shaw cell with flow-wise width variation, *in preparation*

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- Summarizes work
- Jogs audience memory
- Prompts questions
- Emphasizes new contributions to the field

Another one!