

Fast Movements: Nature, Robotics and Materials

Symposium at the Washington Duke Inn, Duke University

July 19-21, 2022

Check out our [symposium website](#) for more information about the event. [Directions to the Washington Duke Hotel](#).

Free parking is available for local participants - follow the signs for event/conference parking to the left of the Washington Duke hotel.

Sign in/read/post at our Slack workspace (see your email for an invite) to meet and chat with participants about the event, research, and favorite foodie spots around Durham.

Pre-symposium day: July 18, 2022

For attendees arriving the evening prior to the symposium, dinner can be purchased at the hotel (the [Bull Durham Bar](#) offers an excellent array of food), at Duke University's high end food court ([walking directions to the Brodhead Center](#)). Or, a short Uber ride can take you to a number of excellent eating areas around Durham ([here](#) and [here](#) are some lists of excellent local dining spots - and there are many more!).

3-5 pm: You are welcome to tour the Patek Lab (as well as register and upload speed talks). Patek Lab located in 026 (one floor down from main entrance) [Biological Sciences Building on Duke University's campus](#). This is a 0.7 mile walk from the hotel ([click here](#) for walking directions and look for signs to the Patek Lab once you arrive at the building).

7-9 pm: Swing by the [Bull Durham Bar](#) at the Washington Duke Hotel to register and upload speed talks. Look for Patek Lab members hanging out with some boxes and drinks - most likely seated in the outside patio area of the bar.

Day 1: July 19, 2022

Time	Event	Location
8:00 AM	Registration	Presidents Gallery
8:00 AM	Breakfast (<i>all meals are in the conference area only, not in the hotel restaurants; attendees will be responsible for purchases at hotel facilities</i>)	Presidents II, III & IV
8:50 AM	Welcome and Introductory Remarks Sheila Patek and Al Crosby	Presidents I
9:00 AM	Session I: Integrative Dynamics Chair: Greg Sawicki, <i>Georgia Institute of Technology</i>	Presidents I
9:00 AM	<i>Overview & perspectives: Integrative dynamics</i> Greg Sawicki, <i>Georgia Institute of Technology</i>	
9:15 AM	<i>The tuning of elastic systems in biology</i> Zanne Cox, <i>Duke University</i>	
10:00 AM	Break	Presidents Gallery
10:15 AM	<i>Impulsive puncture and expansion of soft materials</i> Edwin Chan, <i>NIST</i>	
11:00 AM	<i>Exploring energetics: How engineered jumpers overcome biological limits</i> Elliot Hawkes, <i>University of California Santa Barbara</i>	
11:45 AM	<i>Preview to Session II and Session III</i> Zeynep Temel, <i>Carnegie Mellon University</i> Sam Stanton, <i>Air Force Academy</i>	
12:00 PM	Lunch	Presidents II, III & IV
1:30 PM	Free time: Optional activities, Networking & Discussion Optional activity: <i>High speed imaging systems demonstrations</i> Optional activity: <i>Models, robots, and materials demonstrations by symposium participants</i>	
3:30 PM	Session II: Speed talks & Poster Session I Chair: Zeynep Temel, <i>Carnegie Mellon University</i>	Presidents I
3:30 PM	Speed Talks I	

Adriane Fernandes Minori: *Power amplification for jumping soft robots actuated by artificial muscles*

Michael Dickey: *Soft actuators based on liquid metal*

Yue Zheng: *Anomalous inflation of a nematic balloon*

Katharine Jensen: *Adhesive contact dynamics*

Michael Rosario: *Making materials testing and high speed kinematics accessible with open source tools*

Boyuan Chen: *Towards generalist robots through visual world modeling*

Jacob Harrison: *Ultrafast motion and cavitation emerge at the millimeter scale in juvenile snapping shrimp*

Justin Jorge: *Comparative biomechanics of energy storage and release across seed-shooting witch hazels*

Bingyang Zhang: *Modeling biological puncture: a mathematical framework for determining the energetics and scaling*

Philip Anderson: *Modeling biological puncture: Applying a mathematical model to physical experiments and biological diversity*

Nak-seung Patrick Hyun: *Bifurcation analysis of latch mediated spring actuated (LaMSA) system*

Marie Janneke Schwaner: *Latch your step! Evidence of a LaMSA mechanism in the distal leg of guinea fowl*

Manny Azizi: *Can a trade-off between force and accuracy explain variation in biological LaMSA?*

Ophelia Bolmin: *Interlocking Metasurfaces: a joining technology for bio-inspired fast moving robots*

4:30 PM

Poster Session I

Sathvik Divi: *Using latches for modulating energy and power output in ultrafast systems*

Luis Viorney: *Achieving extensive control over a grasshopper-leg-inspired catapult mechanism*

Roarke Horstmeyer: *Computational imaging approaches to measure high-speed movement*

Xiaoyue Ni: *A dynamically reprogrammable metasurface with self-evolving shape morphing*

Meredith Taghon: *Soft adhesive latches for controlling recoiling band kinematics*

Nolan Miller: *Repeatable power amplified actuation of confined polymer gels*

Kaeshav Danesh: *The limitations of tuning LaMSA systems using stored elastic energy*

James Clinton: *Investigating motor-spring trade-offs in robotic mechanisms at different sizes*

Chloe Goode: *Rotational control in LaMSA jumpers*

Gregory Sutton: *Semi-lunar process shape and energy storage*

Jessica Taylor: *Energy compensation of LaMSA jumpers jumping from compliant platforms*

Elliot Hawkes: *Jumping on air: Design and modeling of latch-mediated, spring actuated air-jumpers*

6:00 PM

Dinner

Presidents II,
III, IV

7:30 PM

Session III: Biology Big Picture

Presidents I

Chair: Sam Stanton, *Air Force Academy*

7:30 PM

Overview & perspectives: Fast movements in nature
Sam Stanton, *Air Force Academy*

7:45 PM

Exquisite energetics: Rapidly recoiling structures in organisms propel the fastest, repeated-use movements on the planet
Sheila Patek, *Duke University*

8:45 PM

Evening Social

Optional: NC Biology Nightlife - black-lighting event outside to view local insects

Day 2: July 20, 2022

8:00 AM	Breakfast	Presidents II, III, IV
9:00 AM	Session IV: Contact Energy Transfer Chair: Sarah Bergbreiter, <i>Carnegie Mellon University</i>	Presidents I
9:00 AM	<i>Overview & perspectives: Contact energy transfer</i> Sarah Bergbreiter, <i>Carnegie Mellon University</i> (filling in for Jennifer Taylor, <i>Scripps Institute of Oceanography</i>)	
9:15 AM	<i>Computational design of hydrogel active structures and soft robots</i> Vicky Nguyen, <i>Johns Hopkins University</i>	
10:00 AM	Break	Presidents Gallery
10:15 AM	<i>Microstructural design of the mantis shrimp saddle – A biomineralized spring optimized for storage of elastic energy</i> Ali Miserez, <i>Nanyang Technological University</i>	
11:00 AM	<i>Torque reversal mechanics from shrimp to robots</i> Ryan St. Pierre, <i>University of Buffalo</i>	
11:45 AM	<i>Preview to Session V and Session VI</i> Jeff Olberding, <i>California State University Fullerton</i> Robert Wood, <i>Harvard University</i>	
12:00 PM	Lunch	Presidents II, III & IV
1:30 PM	Free time: Networking & Discussion	
3:30 PM	Session V: Speed talks & Poster Session II Chair: Jeff Olberding, <i>California State University Fullerton</i>	Presidents I
3:30 PM	Speed Talks II Jarrod Petersen: <i>Evidence of multiple sites of power amplification in frog muscle</i> Corrine Avidan: <i>A power amplification dyad</i> Amy Rutter: <i>Woodpecker drumming mechanics: A fast drummer or a fast drum?</i> Ethan Wold: <i>Asynchronous muscle dynamics can allow bumblebees to exceed their mechanical resonance frequency</i> Elio Challita: <i>How sharpshooter insects exploit biological superpropulsion to catapult their droplet pee</i>	

Saad Bhamla: *Fast movements in single cells - how they are powered and how to build synthetic cell “robots”*

Victor Manuel Ortega Jimenez: *Explosive jumping, aerial acrobatics and controlled landing of nematodes and springtails*

Dwight Whitaker: *Optimality of peat moss vortex rings*

Maya deVries: *Feeding in the benthos: morphology, material properties, and trophic ecology of macroinvertebrates in coral reefs and kelp forests*

Jasmine Nirody: *Environmentally-driven structural changes in bacterial flagella*

Henry Astley: *Frogs as two-stage rockets*

Natasha Mhatre: *Hydraulic forces for jumping in spiders*

Rachel Crane: *Mechanical fatigue and fracture of bivalve shells*

4:30 PM

Poster Session II

Qiong Wang: *Jumping robots by dynamic buckling cascade*

Roi Holzman: *A power amplification dyad in seahorses*

Ruiqi Wang: *High traction legged maneuvers in cockroaches are not limited by ground substrate in naturalistic frictional regimes*

Sojung Yim: *An omnidirectional jumper with expanded movability*

Sang-Min Baek: *Ladybird beetle inspired compliant origami with energy storage and self-locking*

Jiehao Chen: *UV-reprogrammable hydrogel for shape morphing metamaterial with tunable bandgap*

Santanu Kundu: *Retraction behavior of a highly stretchable and resilient hydrogel*

Naomi Deneke: *Pressure tunable adhesion of a patterned elastomer*

David Sleboda: *How to build thin-walled cell models using 3D-printed molds and pourable silicone*

Brittan Wilcox: *Multifunctional shape-changing robots through bi-stable actuation*

Jinchang Zhu: *Voxelated bioprinting of mechanically robust*

multiscale porous scaffolds for pancreatic islets

Ardian Jusufi: *Mechanically and materials mediated
crash-landing on a wall: Soft robotic models of gliding
geckos with varying body and tail stiffnesses*

6:00 PM	Dinner	Presidents II, III, IV
7:30 PM	Session VI: Robotics Big Picture Chair: Robert Wood, <i>Harvard University</i>	Presidents I
7:30 PM	<i>Overview & perspectives: Fast moving robotics</i> Robert Wood, <i>Harvard University</i>	
7:45 PM	<i>Actuator design for dynamic motion and impact</i> Sangbae Kim, <i>Massachusetts Institute of Technology</i>	
8:45 PM	Evening Social <i>RAIN DATE: optional: NC Biology Nightlife - black-lighting event outside to view local insects</i>	

Day 3: July 21, 2022

8:00 AM	Breakfast	Presidents II, III, IV
9:00 AM	Session VII: Recoil & Latching Chair: Mark Ilton, <i>Harvey Mudd College</i>	Presidents I
9:00 AM	<i>Overview & perspectives: Introduction to recoil and latching</i> Mark Ilton, <i>Harvey Mudd College</i>	
9:15 AM	<i>Dynamic response of soft materials</i> Clive Siviour, <i>Oxford University</i>	
10:00 AM	Break	Presidents Gallery
10:15 AM	<i>How carnivorous plants achieve fast motion to capture prey</i> Ulrike Muller, <i>California State University, Fresno</i>	
11:00 AM	<i>Pop! The kinematics, dynamics, and power flow of ultrafast movements in click beetles</i> Aimy Wissa, <i>Princeton University</i>	
11:45 AM	Closing Remarks and Discussion Chair: Al Crosby, <i>University of Massachusetts, Amherst</i>	
12:15 PM	Lunch (Carry Out Style)	Presidents II, III & IV
1 pm	Symposium ends	
3-5 pm	Optional tour of the Patek Lab which is located in 026 (one floor down from main entrance) Biological Sciences Building on Duke University's campus . This is a 0.7 mile walk from the hotel (click here for walking directions and look for signs to the Patek Lab once you arrive at the building).	

Map of symposium rooms in the conference wing of the Washington Duke Hotel.

The rooms used by this event are indicated with a blue arrow.

