ICRA 2019 International Conference on Robotics and Automation

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- Some pictures at ICRA2019
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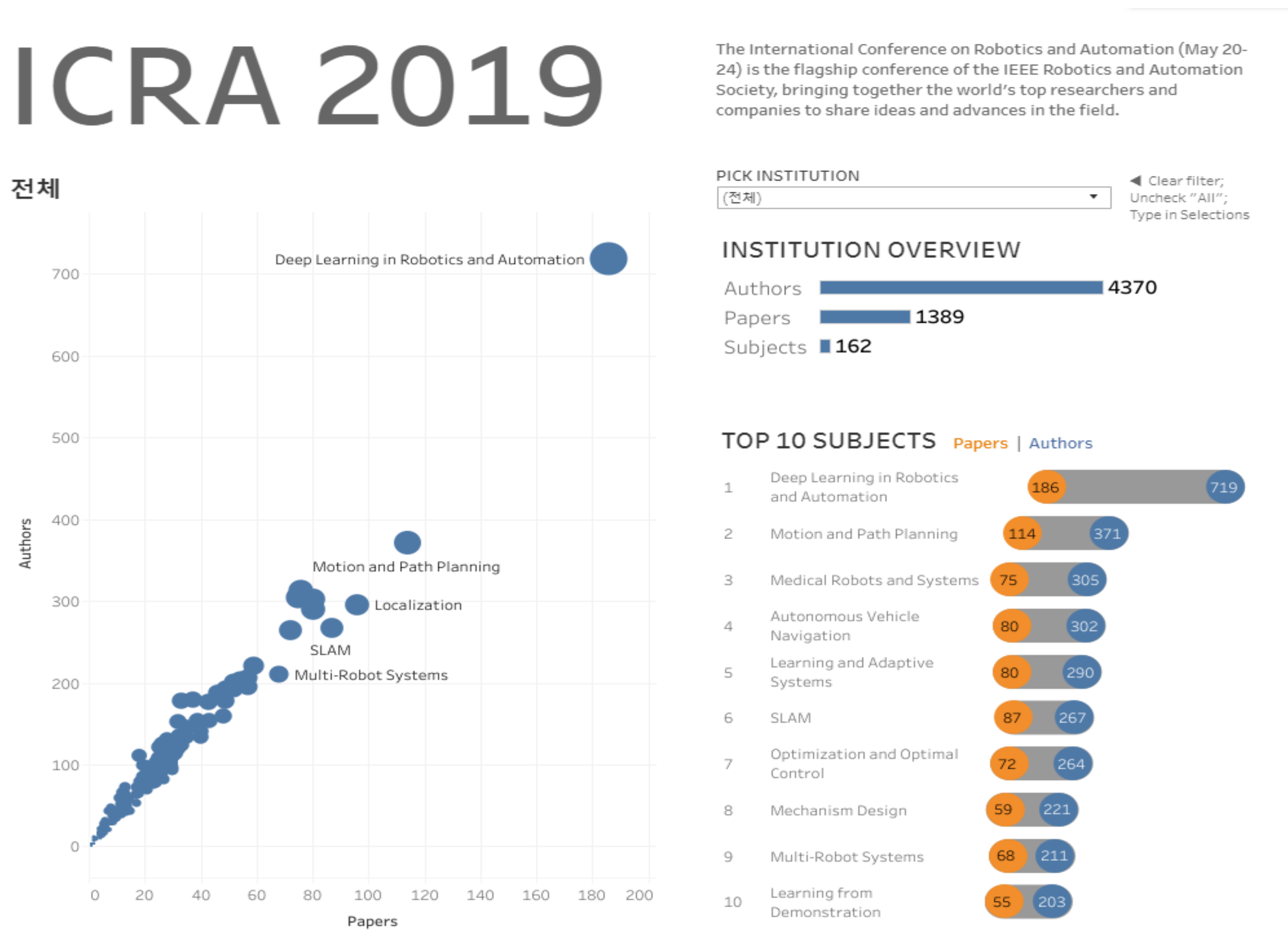
- What I've got

Some pictures at ICRA 2019

Some pictures at ICRA 2019

4,145 PARTICIPANTS	71 COUNTRIES	2,903 PAPER SUBMISSIONS
1,347 PAPER PRESENTATIONS	9 INVITED SPEAKERS	93 SPONSORS AND EXHIBITORS
5 INTERNATIONAL ARTISTS	3 MAJOR COMPETITIONS	130 STUDENT VOLUNTEERS

Some pictures at ICRA 2019



Some pictures at ICRA 2019

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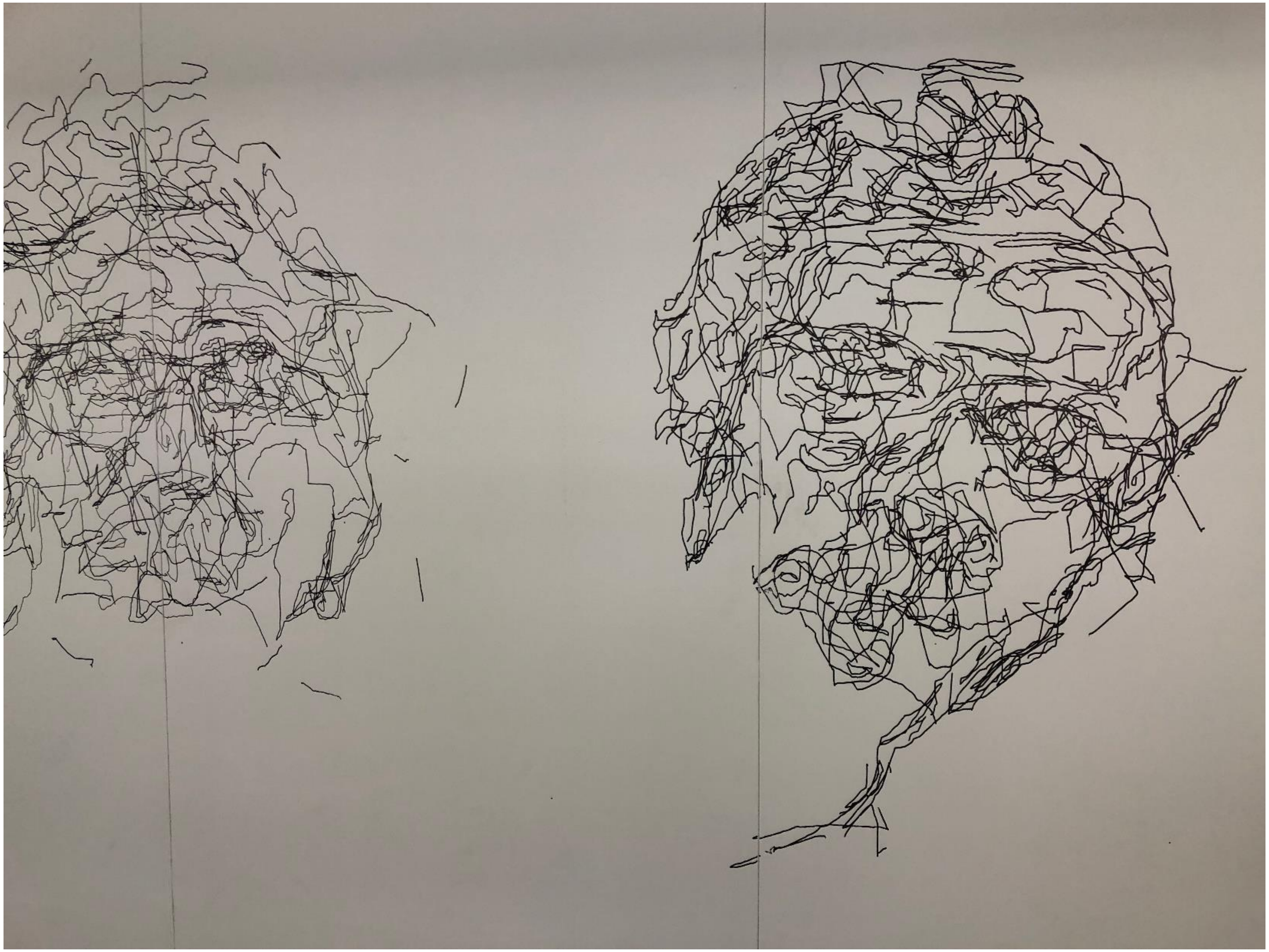
Some pictures at ICRA 2019



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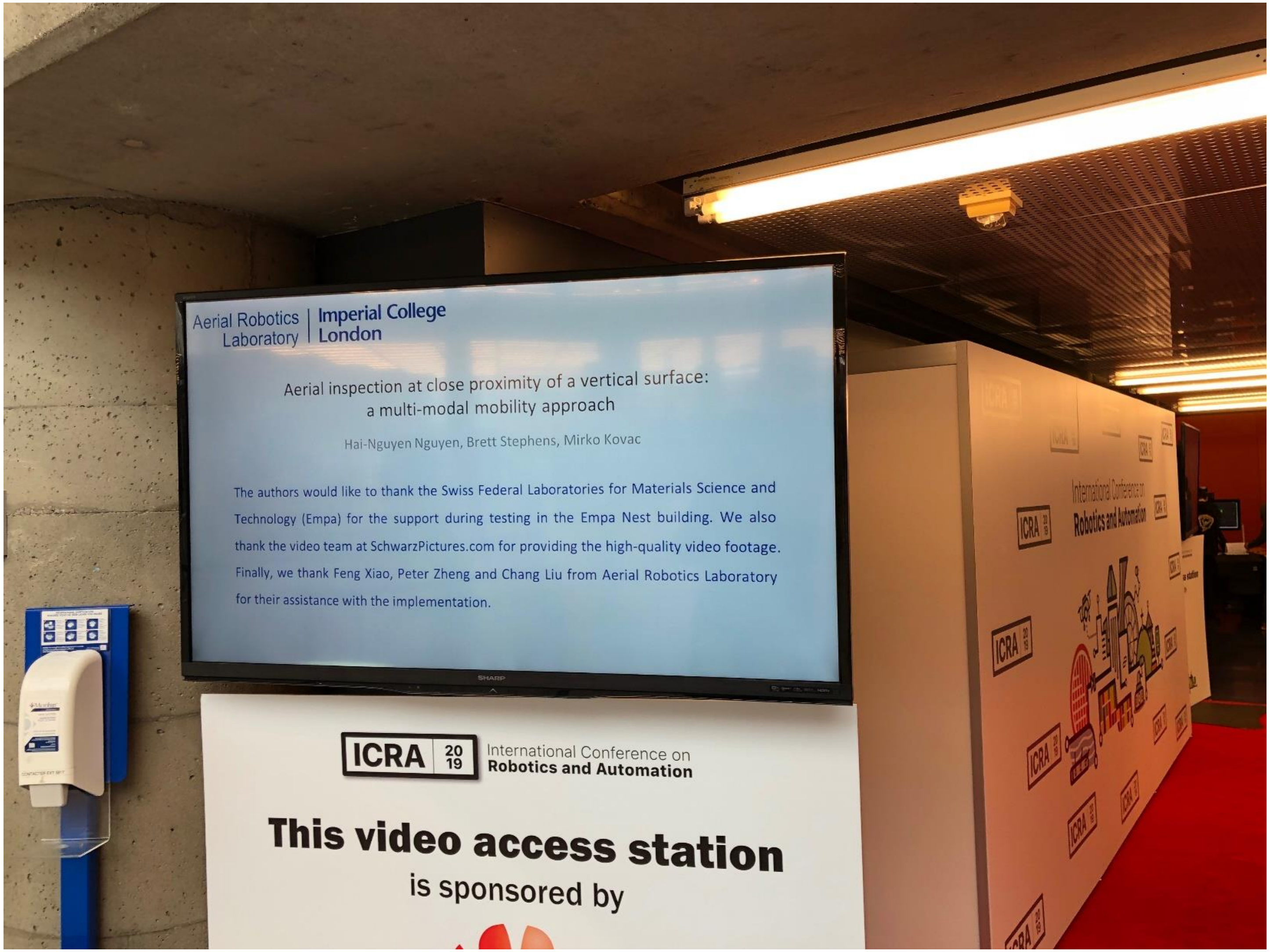
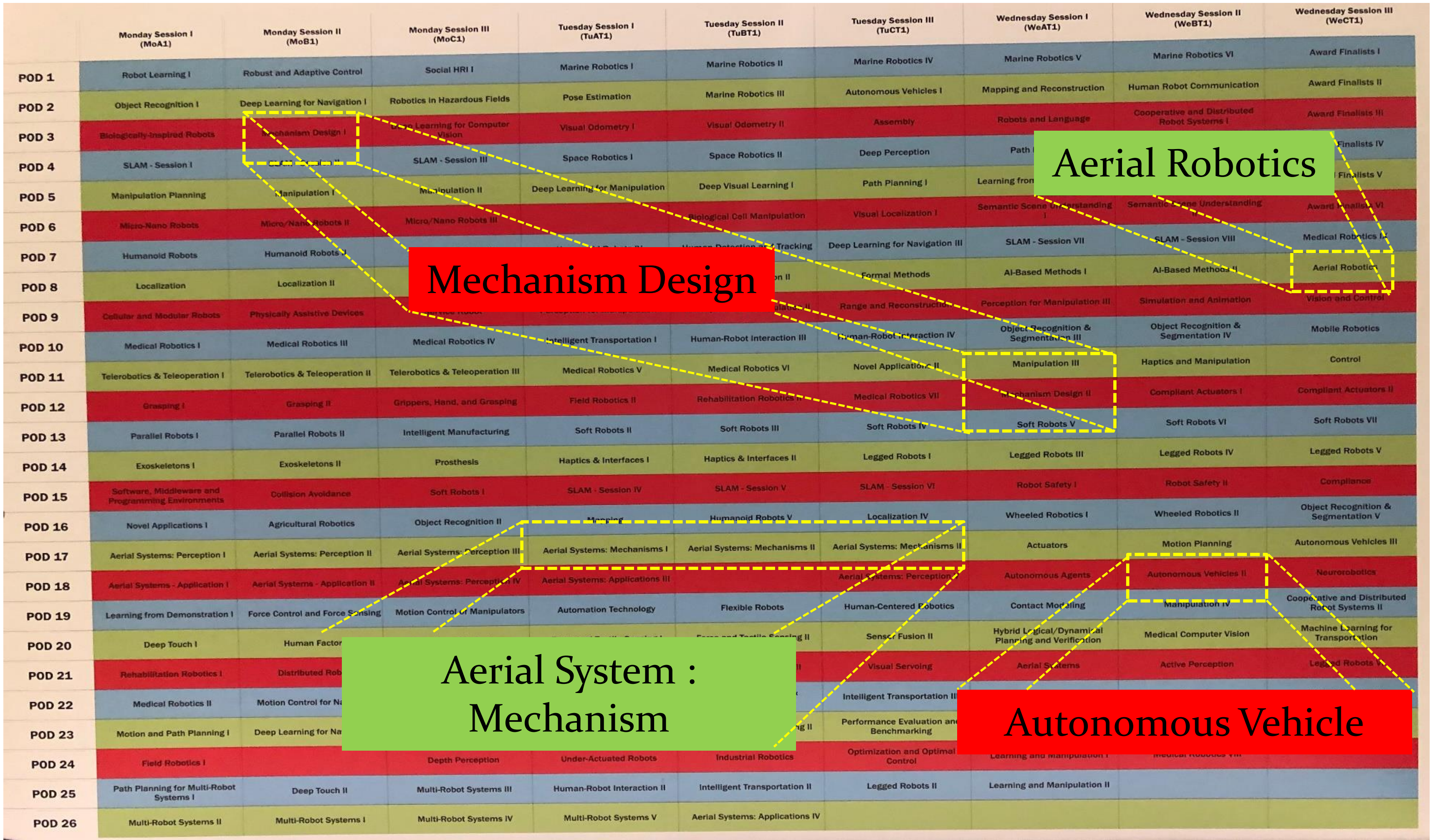


Some pictures at ICRA 2019

- Interactive session



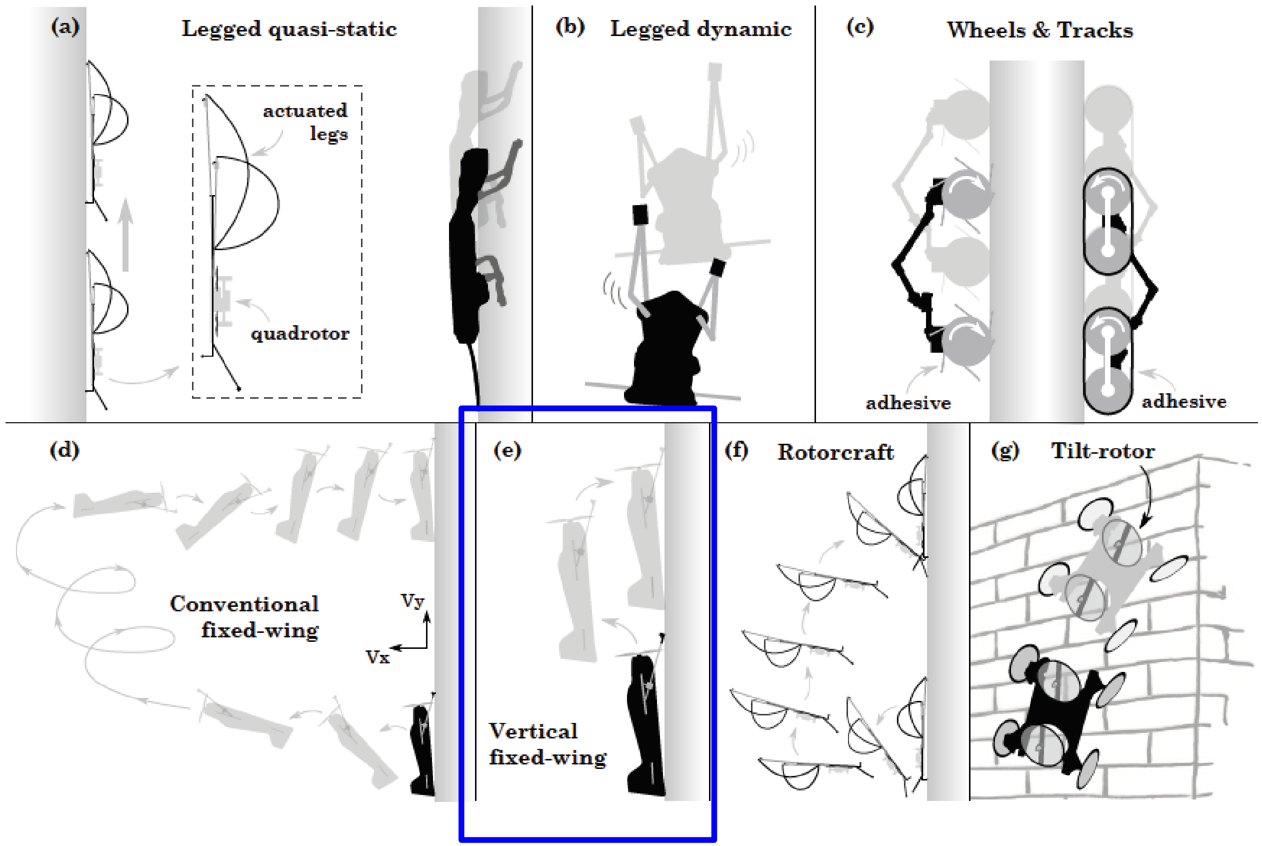
Interesting papers

Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs
 - Dino Mehanovic, David Rancourt, Alexis Lussier Desbiens (Universit´e de Sherbrooke, Createk Lab)

Power-Minimizing Control of a Variable-Pitch Propulsion System for Versatile Unmanned Aerial Vehicles
- Travis Henderson and Nikolaos Papanikolopoulos (Department of Computer Science and Engineering, University of Minnesota)

Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs

- There is a lot of robotic climbing strategies tested on vertical surfaces



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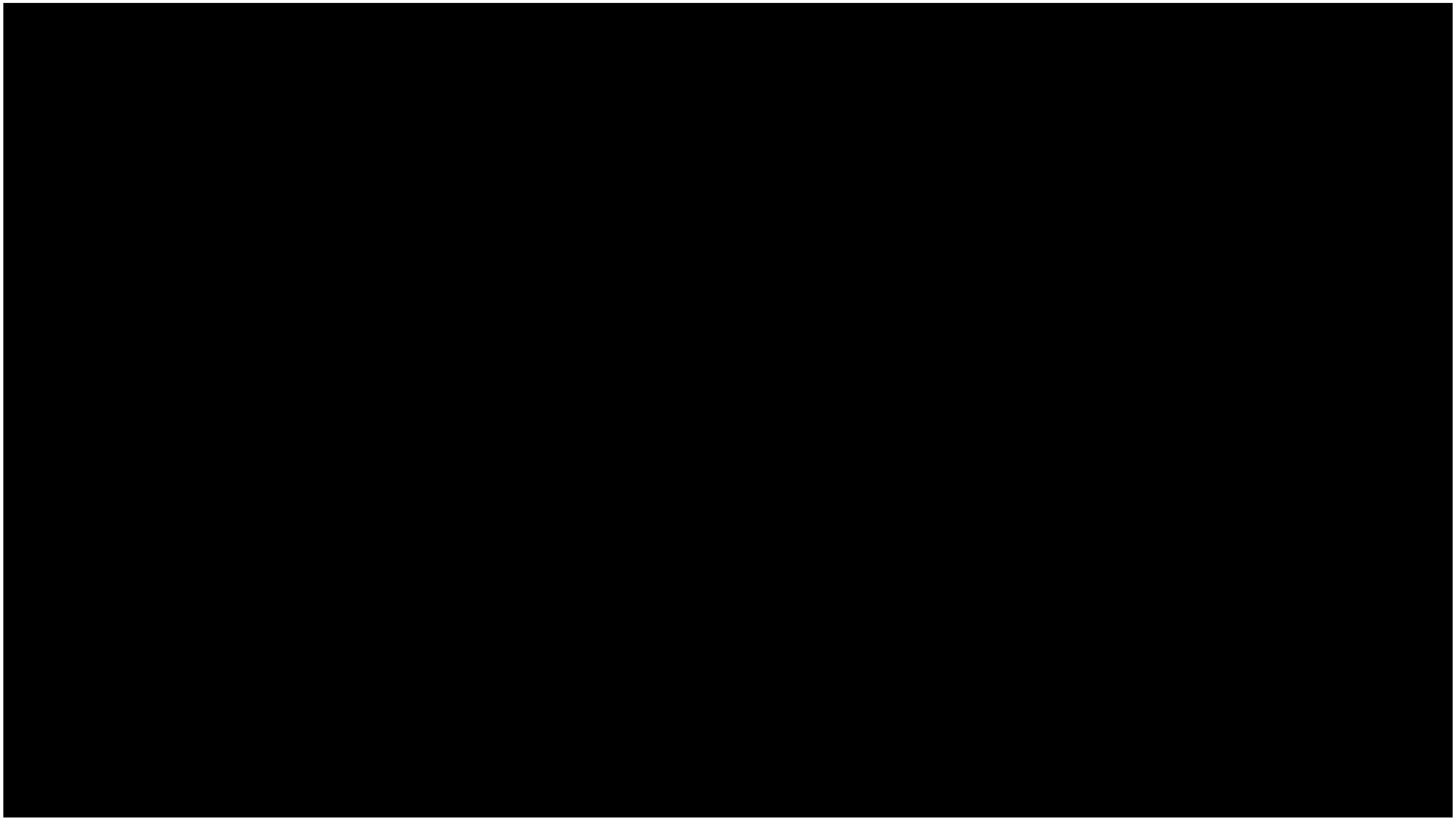
Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs

- It is called S-MAD(Sherbrooke's Multimodal Autonomous Drone)
- Microspines to be attached onto vertical surfaces
- It descents like birds
- Limitation: Only procedure until attached was presented

1. D. Mehanovic et al., "Autonomous thrust-assisted perching of a fixedwing uav on vertical surfaces," in Conference on Biomimetic and Biohybrid Systems, 2017.

Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs

- Previous version of S-MAD

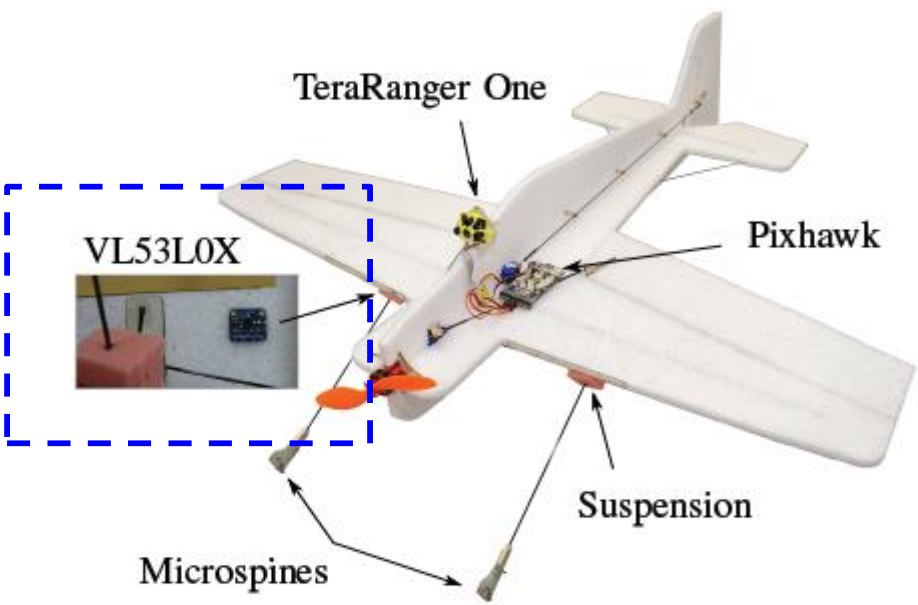


Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs

- Future work includes various improvements on the system
  - More precise estimation of the vertical velocity and a mass reduction of the suspension
  - Inclusion of non-contact sensors to turn off the propeller pre-emptively by early detection of incoming touchdowns
  - For longer term, extend the performance for **thrust-assisted wall climbing**, aborted approaches and recovery from failed attachment

Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs

- Advanced version of S-MAD which is able to do wall-climbing was presented



Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs

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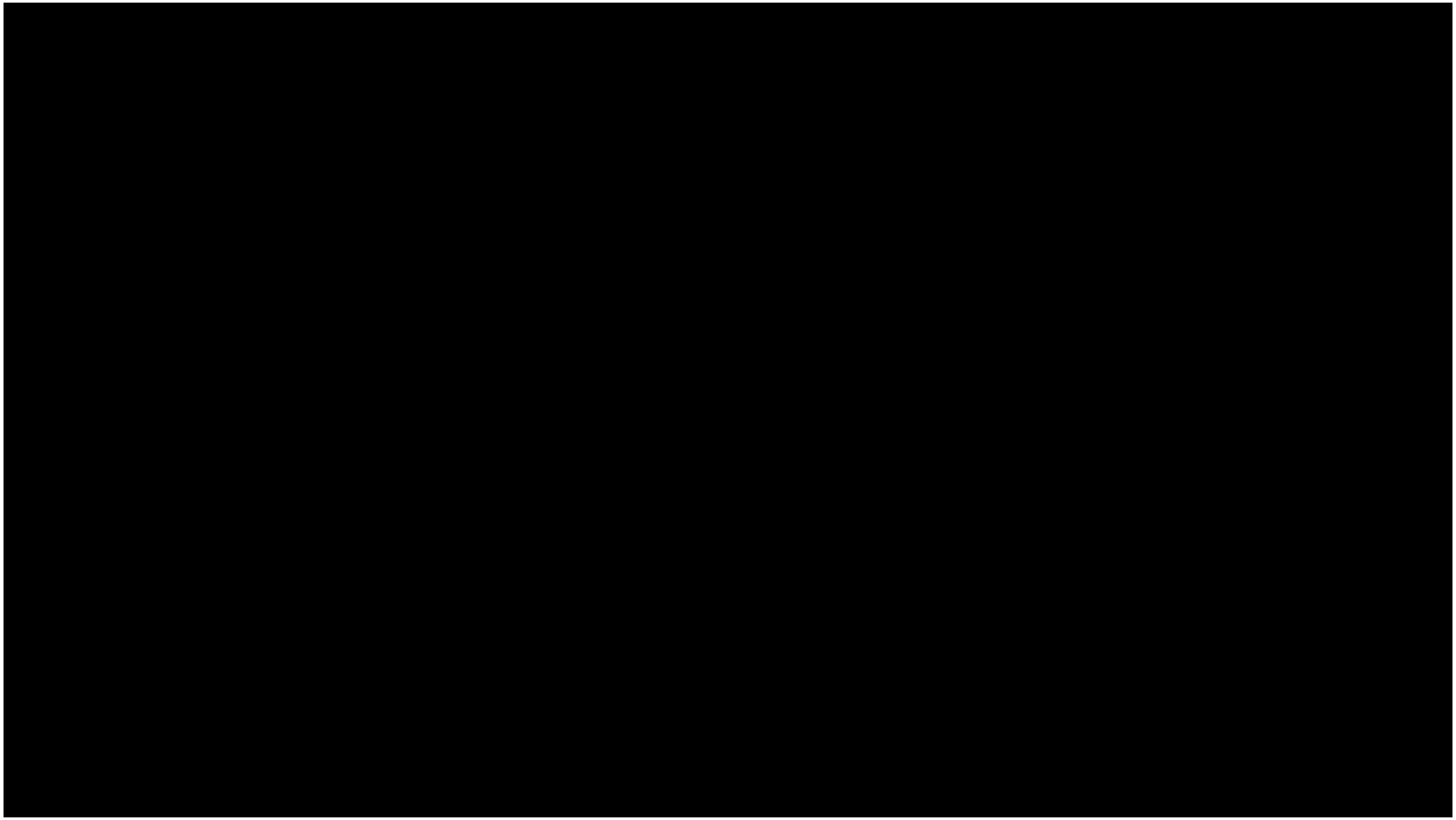
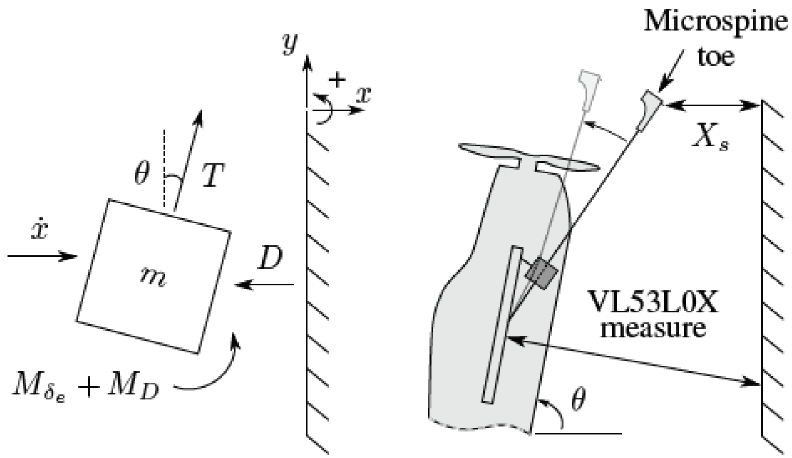
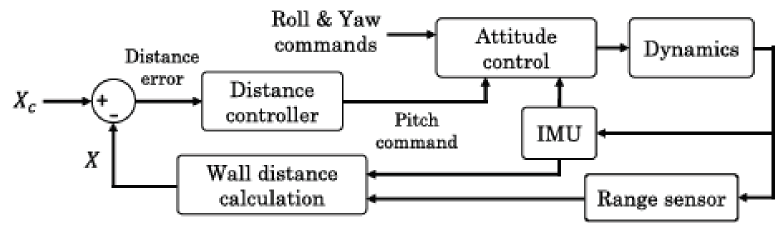


Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs

- The control of propulsion system is performed through constant or time-dependent commands



(a) (b)



1) **Takeoff and climb:** the maximum thrust command (about $1.5mg$) is sent for a duration that is function of the height to be climbed, as full throttle maximizes efficiency (Section III).
2) **Slow down and landing:** a constant thrust command slightly lower than mg is sent for 0.5 s. This adds robustness by ensuring that the system does not fall too fast downward if the microspines are not immediately inserted into asperities at touchdown.
3) **Relaxation:** a ramp-down command, from a 65% thrust to 0%, allows the airplane to settle down at its new position and avoid propeller contact with the surface, while engaging microspines.

Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs

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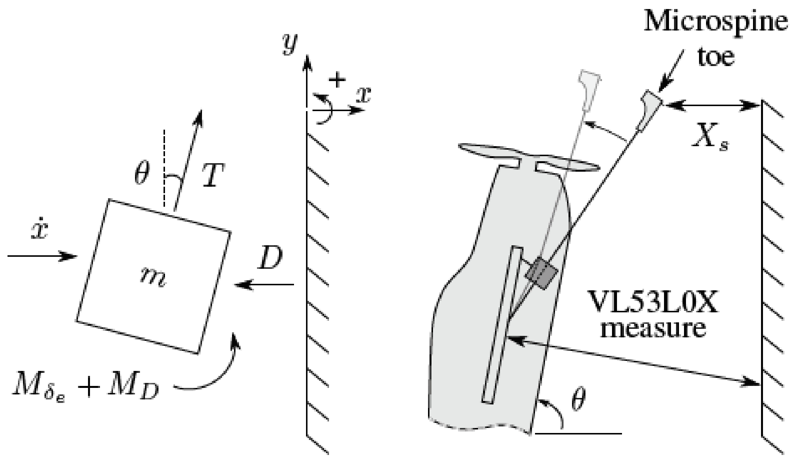

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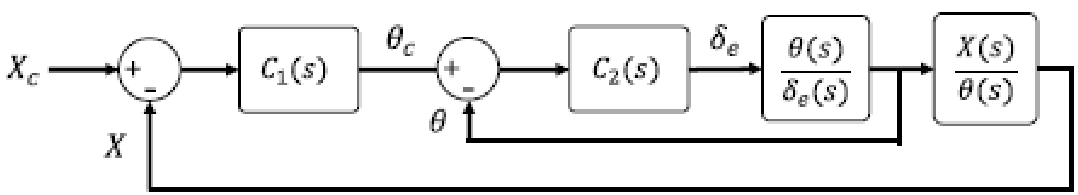


The equation of motion:

$$T\theta - D = m\ddot{x}$$
$$M_{\delta_e} + M_D = I\ddot{\theta}$$

The second-order systems:

$$\frac{X(s)}{\theta(s)} = \frac{T}{ms^2 + cs}$$

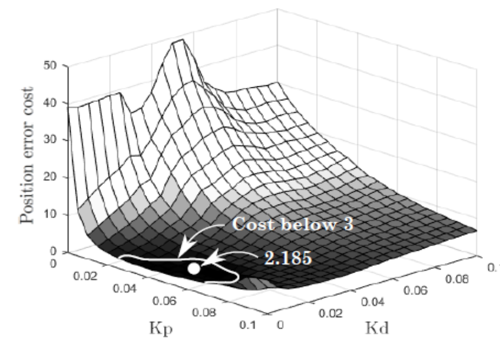
$$\frac{\theta(s)}{\delta_e(s)} = \frac{M}{Is^2 + bs}$$

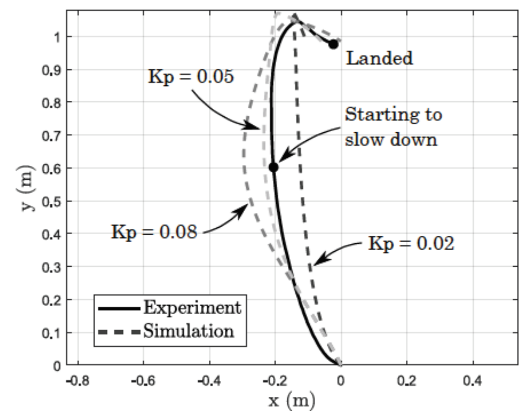
Fast and Efficient Aerial Climbing of Vertical Surfaces Using Fixed-Wing UAVs

- Result
  - Desired CM distance is 0.18m away from the wall
  - Cost function

$$J = \int_{t_0}^{t_1} x_e^2 \, dt$$

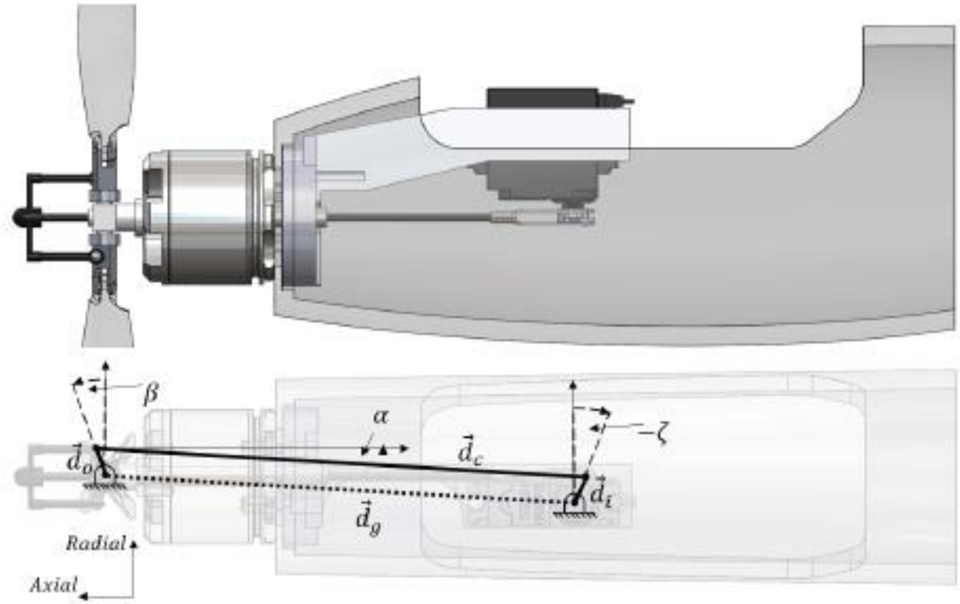
  - K_p=0.05 and K_d=0 is selected from simulation result(shown in dashed)





- Future work
  - Focus on allowing the system to perch on more varied surfaces (e.g., glass)
  - Detect and recover from slips, and perform autonomous missions involving climbing and transitions between different vertical surfaces.

Power-Minimizing Control of a Variable-Pitch Propulsion System for Versatile Unmanned Aerial Vehicles



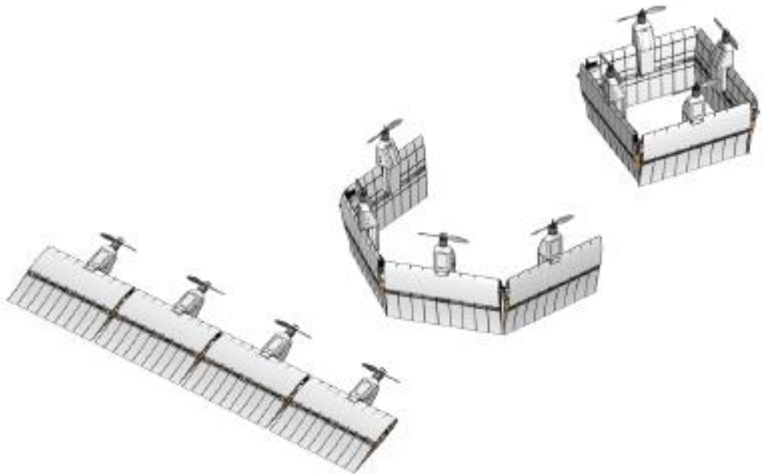
$$\beta_2 = -i ln(\frac{1}{d_0}(d_0 e^{i\beta_1} + d_c e^{i\Delta\alpha} + d_i e^{i\Delta\zeta}))$$

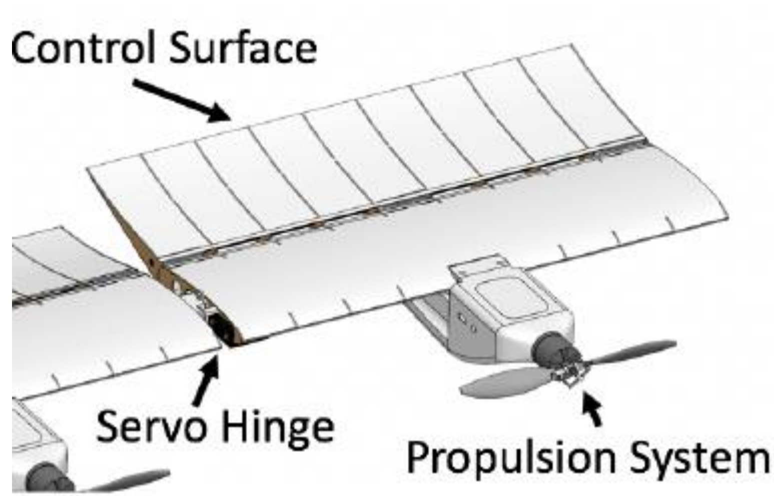
Interesting videos

Design and Experiments for Multi-Section-Transformable (MIST)-UAV
- Ruben D'Sa and Nikolaos Papanikolopoulos (Department of Computer Science and Engineering, University of Minnesota)

Aerial Inspection at Close Proximity of a Vertical Surface: a Multi-Modal Mobility Approach
- Hai-Nguyen Nguyen, Brett Stephens, Mirko Kovac (Aerial Robotics Lab, Imperial College London, UK)

Design and Experiments for MultI-Section-Transformable (MIST)-UAV





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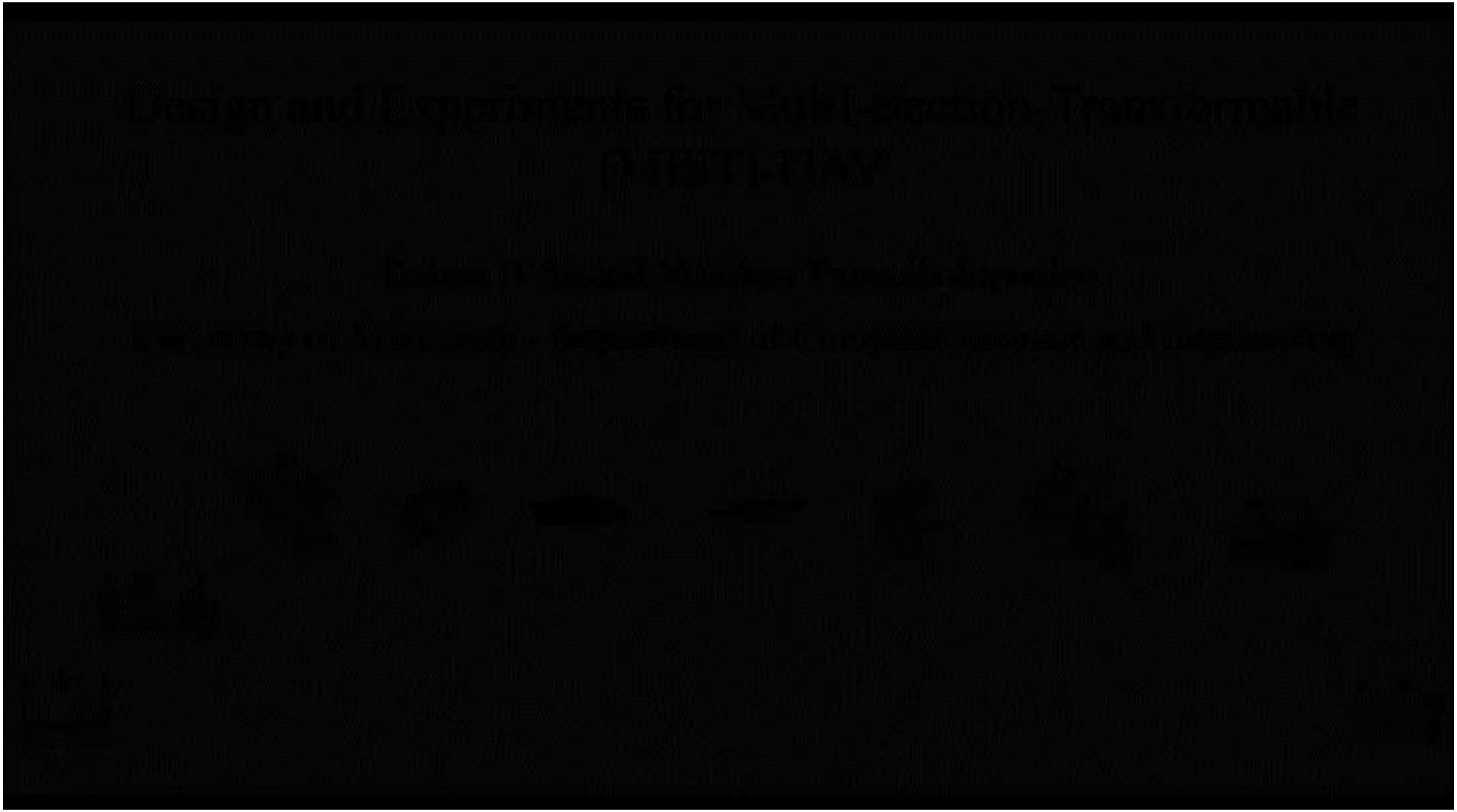
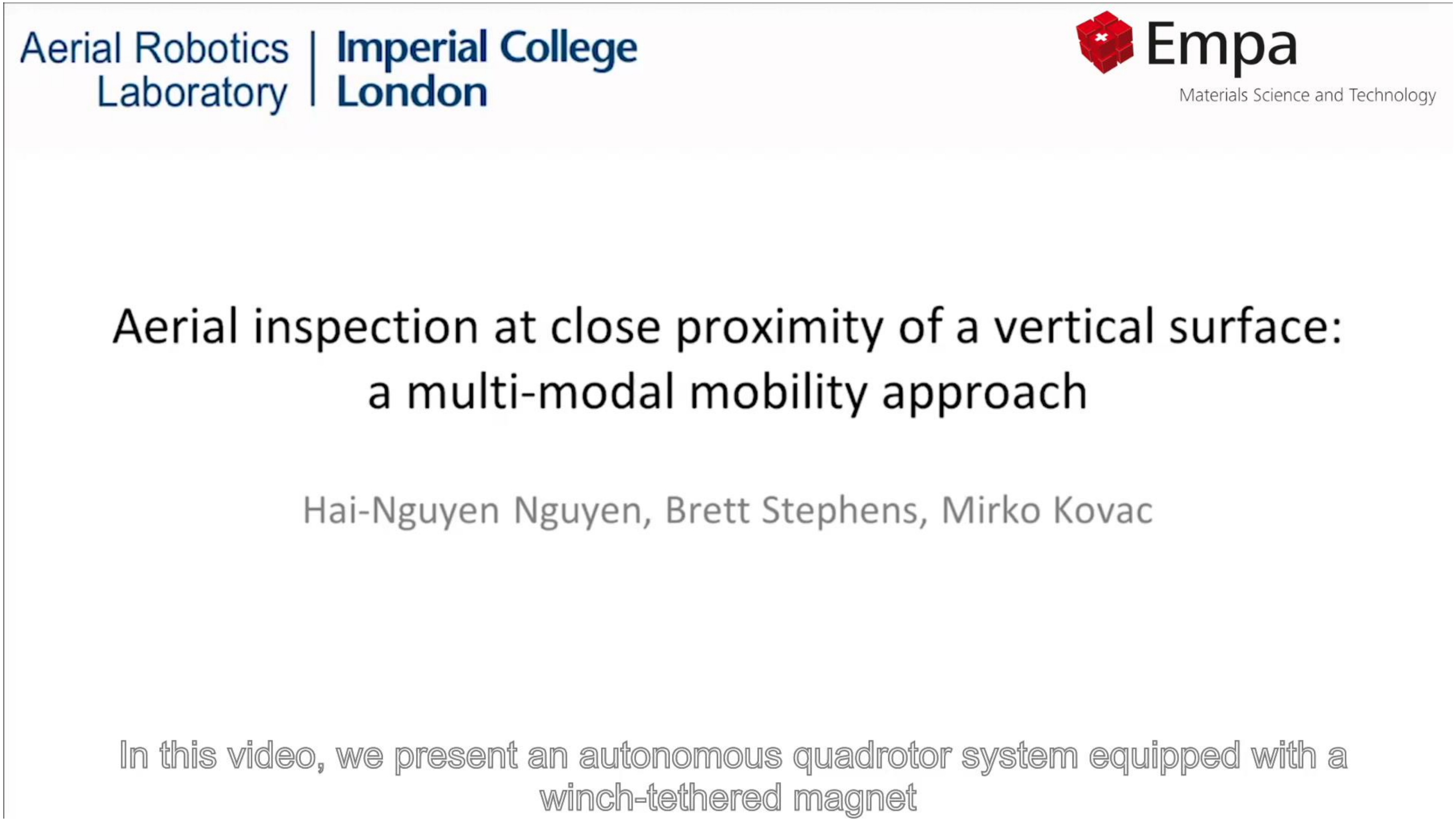


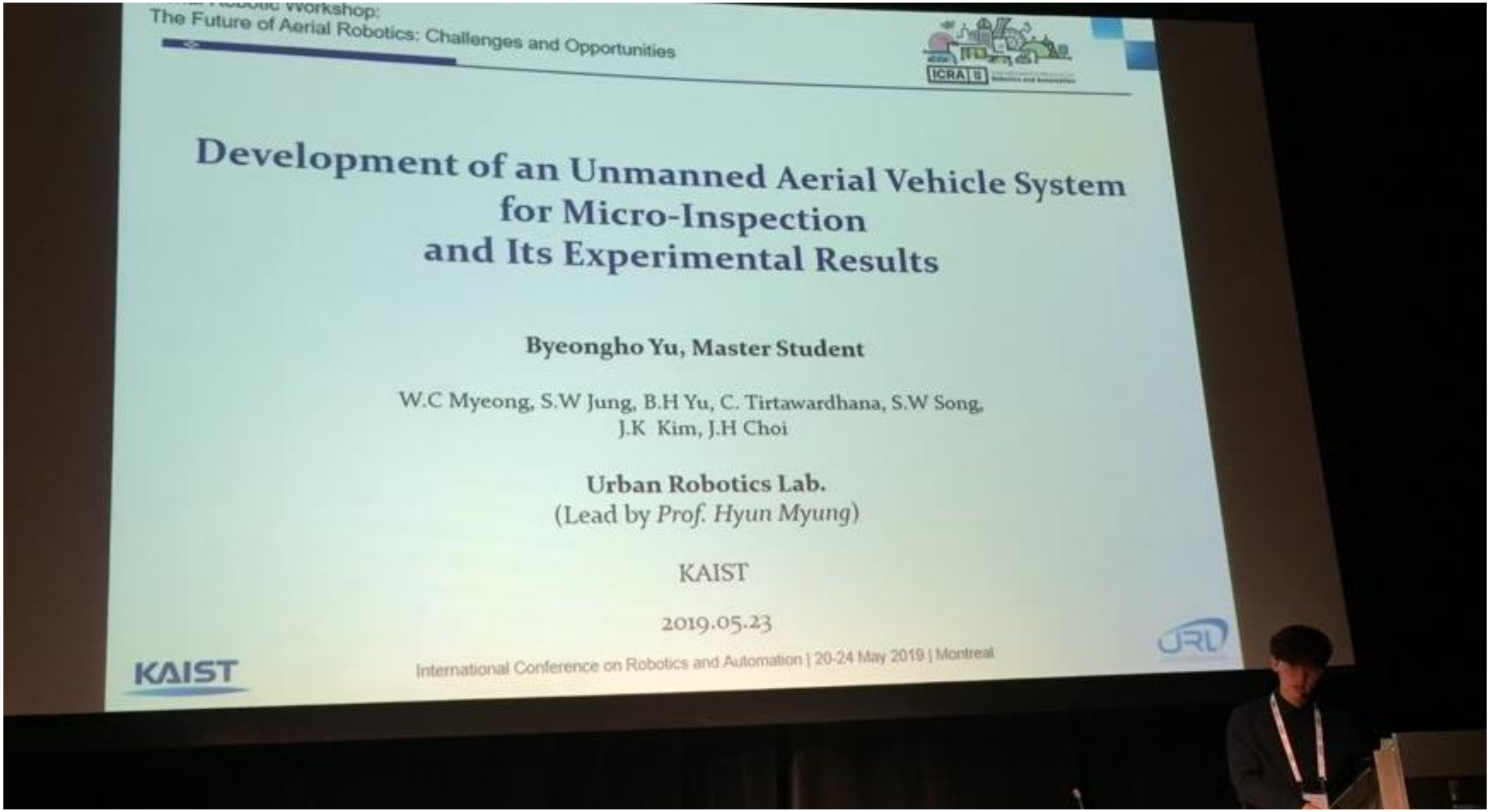
Aerial Inspection at Close Proximity of a Vertical Surface: a Multi-Modal Mobility Approach



What I've got

Experience

- Give a presentation at Aerial Robotics Workshop



Motivation

- Each of presenters has been struggling in their own field
- Complete themselves from the beginning to the end including both building a platform up and control
- Our idea, CAROS, is original compared to others

Thank you