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• Some pictures at ICRA2019

Interesting papers & videos

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The International Conference on Robotics and Automation (May 20-24) is the flagship conference of the IEEE Robotics and Automation Society, bringing together the world's top researchers and companies to share ideas and advances in the field.

#### 

•	Uncheck "All";
	Type in Selections

#### INSTITUTION OVERVIEW



#### TOP 10 SUBJECTS Papers | Authors

Deep Learning in Robotics 1 and Automation 2 Motion and Path Planning Medical Robots and Systems 2 Autonomous Vehicle 4 Navigation Learning and Adaptive 5 Systems SLAM 6 Optimization and Optimal Control 8 Mechanism Design Multi-Robot Systems 9 Learning from Demonstration























#### Interactive session

	Monday Session I	Monday Session II	Monday Session III (MoC1)	Tuesday Session I (TuAT1)	Tuesday Session II (TuBT1)	Tuesday Session III (TuCT1)	Wednesday Session I (WeAT1)	Wednesday Session II (WeBT1)	Wednesday Session III (WeCT1)
	(MoA1)	(WOBI)	Social HRI I	Marine Robotics I	Marine Robotics II	Marine Robotics IV	Marine Robotics V	Marine Robotics VI	Award Finalists I
POD 1	Robot Learning I	Robust and Adaptive Control	Debatics in Navardous Fields	Pose Estimation	Marine Robotics III	Autonomous Vehicles 1	Mapping and Reconstruction	Human Robot Communication	Award Finalists II
POD 2	Object Recognition I	Deep Learning for Navigation 1	Robotics in Hazdroods Fields	Visual Odometry I	Visual Odometry II	Assembly	Robots and Language	Cooperative and Distributed Robot Systems I	Award Finalists III
POD 3	Biologically-Inspired Robots	Mehaniam Design I	Vision	Space Robotics	Space Robotics II	Deep Perception	Path	:-1 D-h-+	Finalists IV
POD 4	SLAM - Session 1		SLAM - Session III		Deen Visual Learning I	Path Planning I	Learning from	iai kodot	ICS Finalists V
POD 5	Manipulation Planning	Manipulation I	Munipulation II	Deep Learning of manipulation	Biological Call Manipulation	Visual Localization 1	Semantic Scene Universitanding	Semantic Cione Understanding	Award Hinalista VI
POD 6	Micro-Nano Robots	Micro/Nana Robots II	Micro/Nano Robots III			Deep Learning for Navigation III	SLAM - Session VII	SLAM - Session VIII	Medical Robotics IX
POD 7	Humanold Robots	Humanold Robots J	N / 1	· ·	Tacking	Cormal Methods	Al-Based Methods I	Al-Based Methods 4	Aerial Robotics
POD 8	Localization	Localization II	<b>Niech</b>	anism De	esign 💾	Formal methods	Researching for Manipulation III	Simulation and Animation	Vision and Control
POD 9	Cellular and Modular Robots	Physically Assistive Devices			ulabar. 4	Range and Reconstruction	Object Secognition &	Object Recognition &	Mobile Robotics
POD 10	Medical Robotics I	Medical Robotics III	Medical Robotics IV	Intelligent Transportation I	Human-Robot Interaction III	Ruman-Robot Interaction IV	Segmentation III	Segmentation IV	Control
POD 11	Telerobotics & Teleoperation I	Telerobotics & Teleoperation II	Telerobotics & Teleoperation III	Medical Robotics V	Medical Robotics VI	Novel Applications II	Manipulation III	Paptics and maniputation	Compliant Actuators II
POD 12	Grasping I	Grasping II	Grippers, Hand, and Grasping	Field Robotics II	Rehabilitation Robotics n	Medical Robotics VII	al chanism Design II	Compliant Actuators I	Colt Dobate VII
POD 13	Parallel Robots I	Parallel Robots II	Intelligent Manufacturing	Soft Robots II	Soft Robots III	Soft Robots Iv	Soft Robots V	Soft Robots VI	Soft Robots VII
POD 14	Exoskeletons I	Exoskeletons II	Prosthesis	Haptics & Interfaces I	Haptics & Interfaces II	Legged Robots I	Legged Robots III	Legged Robots IV	Legged Robots V
POD 15	Software, Middleware and Programming Environments	Collision Avoidance	Soft Robots I	SLAM - Session IV	SLAM - Session V	SLAM - Session VI	Robot Safety I	Robot Safety II	Compliance
POD 16	Novel Applications 1	Agricultural Robotics	Object Recognition II		Humanoid Robots V	Localization IV	Wheeled Robotics I	Wheeled Robotics II	Segmentation V
POD 17	Aerial Systems: Perception I	Aerial Systems: Perception II	Aerial Systems: Perception III	Aerial Systems: Mechanisms I	Aerial Systems: Mechanisms II	Aerial Systems: Mechanisms II	Actuators	Motion Planning	Autonomous Vehicles III
POD 18	Aerial Systems - Application 1	Aerial Systems - Application II	Annal Systems: Perception IV	Aerial Systems: Applications III		Aerial Systems: Perception	Autonomous Agents	Autonomous Vehicles II	Neurorobolics
POD 19	Learning from Demonstration	Force Control and Force Sonsin	g Motion Control of Manipulators	Automation Technology	Flexible Robots	Human-Centered Fobotics	Contact Mortaling	Manipulation IV	Cooperative and Distributed Rocot Systems II
POD 20	Deep Touch I	Human Factor			Free and Texasing II	Sensor Fusion II	Hybrid Logical/Dynamical Planning and Verification	Medical Computer Vision	Machine Darning for Transportation
POD 21	Rehabilitation Robotics I	Distributed Rob	Aeria	al System		Visual Servoing	Aerial Statems	Active Perception	Legand Robots v
POD 22	Medical Robotics II	Motion Control for N	Т. Л.	1		Intelligent Transportation II			1
POD 23	Motion and Path Planning I	Deep Learning for Na	Me	chanism	ng II	Performance Evaluation an Benchmarking	Auton	omous Ve	ehicle
POD 24	Field Robotics I		Depth Perception	Under-Actuated Robots	Industrial Robotics	Optimization and Optimal Control	Learning and Manipulation I	Includin Robotics vin	
POD 25	Path Planning for Multi-Robo Systems I	t Deep Touch II	Multi-Robot Systems III	Human-Robot Interaction II	Intelligent Transportation II	Legged Robots II	Learning and Manipulation II		
POD 26	Multi-Robot Systems II	Multi-Robot Systems I	Multi-Robot Systems IV	Multi-Robot Systems V	Aerial Systems: Applications IV				



# **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)





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







- 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.



#### Previous version of S-MAD







- 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





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









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







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





- 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.





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





The equation of motion:

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

The second-order systems:

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





#### 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



$$\beta_2 = -iln(\frac{1}{d_0}(d_0e^{i\beta_1} + d_ce^{i\Delta\alpha} + d_ie^{i\Delta\zeta}))$$



# **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









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







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

Aerial Robotics | Imperial College Laboratory | London



#### Aerial inspection at close proximity of a vertical surface: a multi-modal mobility approach

Hai-Nguyen Nguyen, Brett Stephens, Mirko Kovac

In this video, we present an autonomous quadrotor system equipped with a winch-tethered magnet





# What I've got



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# 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



