

DANISH-BAVARIAN WORKSHOP ON ROBOTICS/ICT IN HORIZON 2020

Game of Drones: Challenges, opportunities in aerial robotics

AARHUS UNIVERSITY
ARTIFICIAL INTELLIGENCE IN ROBOTICS GROUP

WHO AM I?

Date	Work experience
April 2018-Current	Associate Professor (Tenured), Aarhus University <i>Department of Engineering</i> <i>Director of Artificial Intelligence in Robotics (AiR) Lab</i>
March 2014-March 2018	Assistant Professor, Nanyang Technological University, Singapore <i>Department of Mechanical and Aerospace Engineering</i>
September 2011-March 2014	Post doctoral researcher, KU Leuven, Belgium <i>Division of Mechatronics, Biostatistics and Sensors (MeBioS)</i>
Date	Education
September 2011	Ph.D. in Electrical and Electronics Engineering, Bogazici University, Istanbul
January 2016	M.Sc. in Systems and Control Engineering, Bogazici University, Istanbul
June 2003	B.Sc. in Electrical Engineering, Istanbul Technical University, Istanbul



RESEARCH PROJECTS

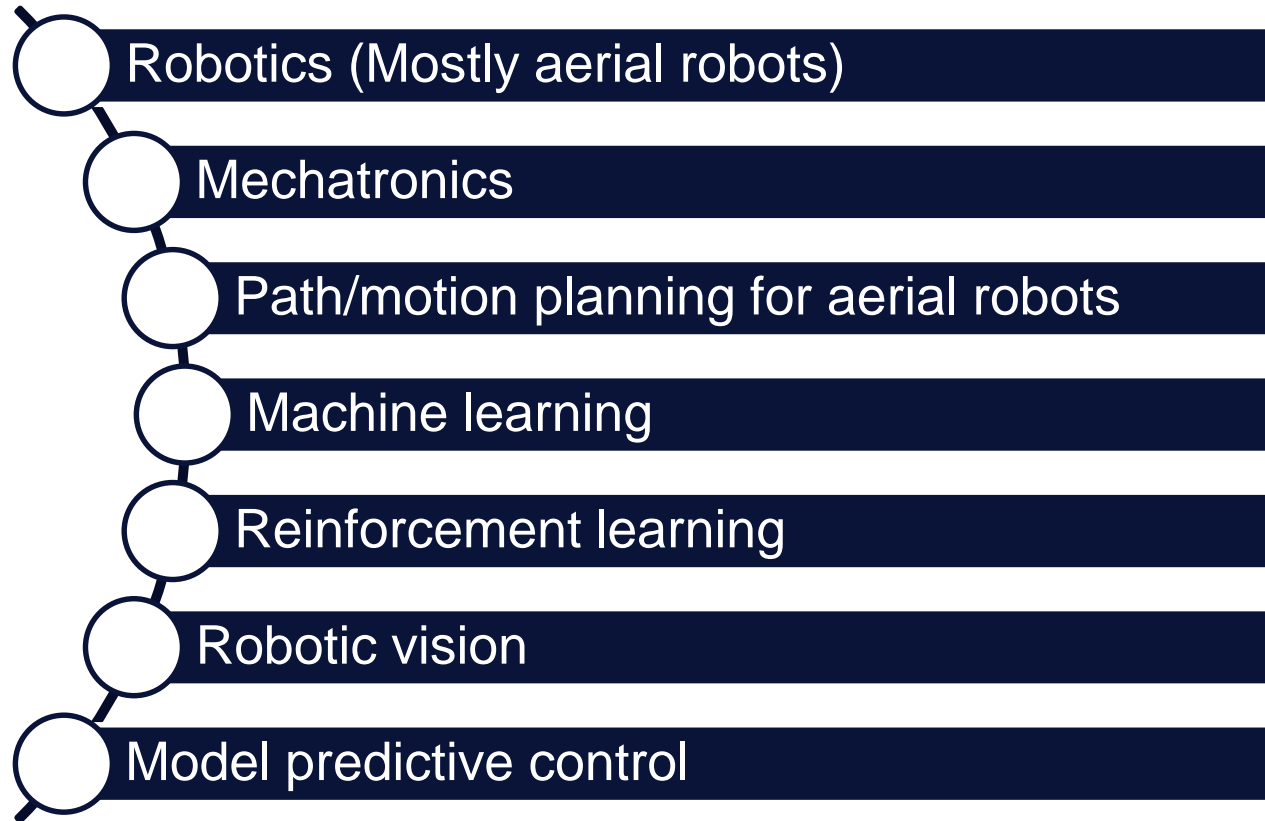
Date	Ongoing
April 2019-Current	Visualisation of Virtual Outcrops Using Aerial Robots <i>by Technical University of Denmark, Danish Hydrocarbon Research and Technology Centre</i>

Date	Directed
March 2018 - March 2019	Learning-based path planning of unmanned aerial vehicles with vision-based sensing <i>by Ministry of Education Academic Research Funding Tier 1</i>
Jan 2016 - April 2018	Fuzzy neural network-based learning control of unmanned aerial vehicles <i>by ST Eng-NTU Corporation Laboratory</i>
Jan 2014 - April 2018	Design of lightweight UAV for 3D Printing <i>by NRF Medium-Sized Centre</i>
Jul 2015 - Dec 2017	Precise landing for unmanned aerial vehicles <i>by ST Eng-NTU Corporation Laboratory</i>
July 2015 - Jan 2017	Quality Inspection and Assessment Robot (Quicabot) <i>by JTC Corporation - NRF Singapore</i>
May 2014 - Mar 2017	Learning control algorithms for unmanned aerial vehicles <i>by Nanyang Technological University (Start up grant)</i>
Mar 2015 - Aug 2017	Model predictive control-moving horizon estimation framework as applied to tilt rotor UAVs and its experimental evaluation <i>by Ministry of Education Academic Research Funding Tier 1</i>

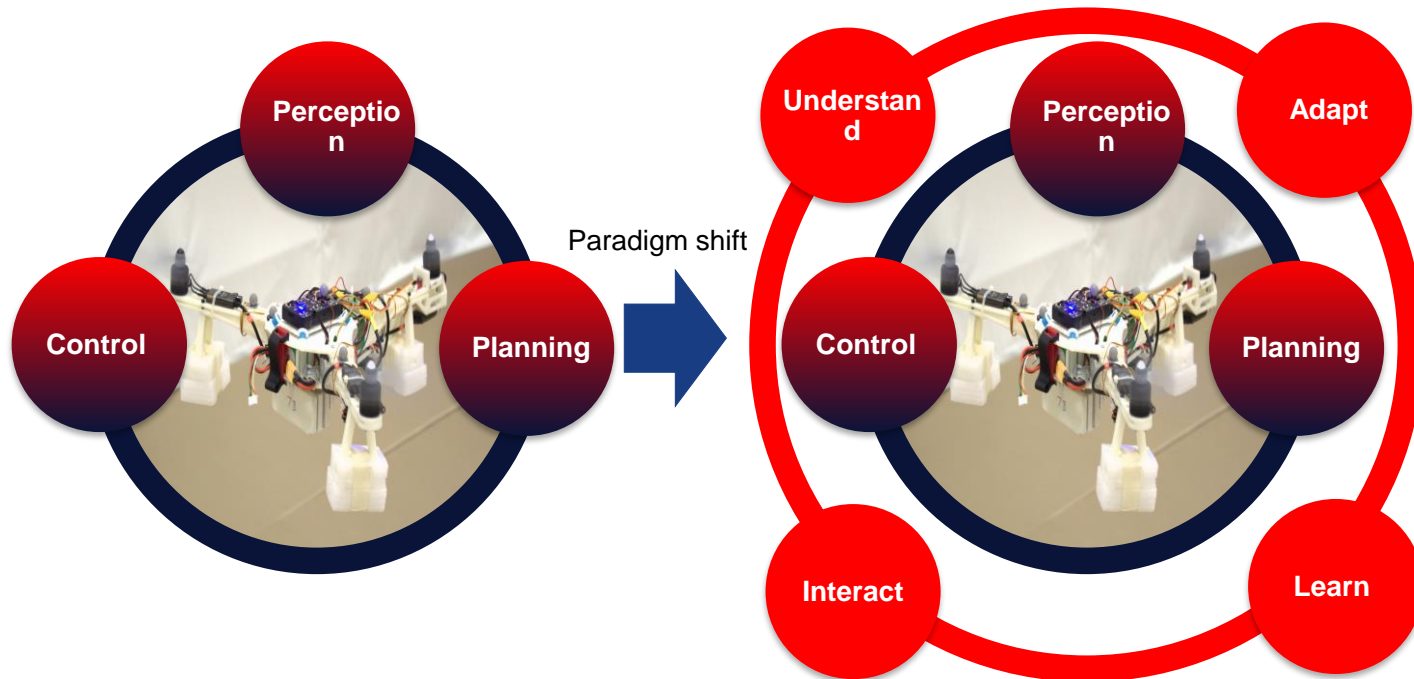


A new project: "Open Deep Learning toolkit for Robotics" project will be funded by EU under the HORIZON 2020 program!

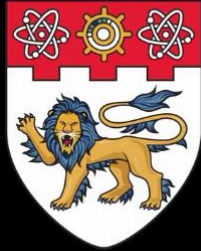
RESEARCH AREAS



ESSENTIAL UNITS IN ROBOTS



LEARNING CONTROL USING ANNS



**NANYANG
TECHNOLOGICAL
UNIVERSITY**
SINGAPORE



**AARHUS
UNIVERSITY**

A Fast Learning Control Strategy for Unmanned Aerial Manipulators

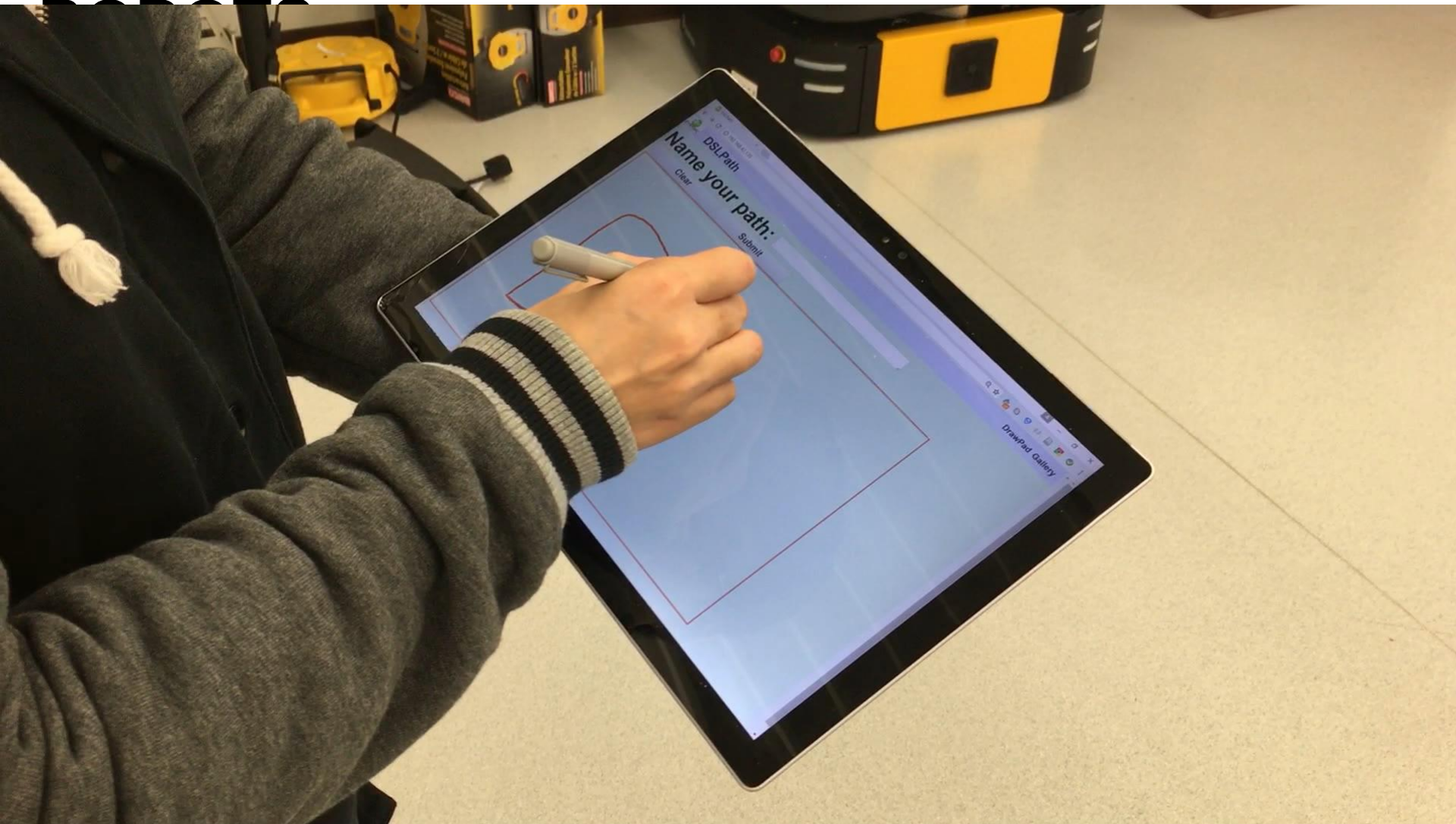
Nursultan Imanberdiyev and Erdal Kayacan

**School of Mechanical and Aerospace Engineering,
Nanyang Technological University, Singapore**

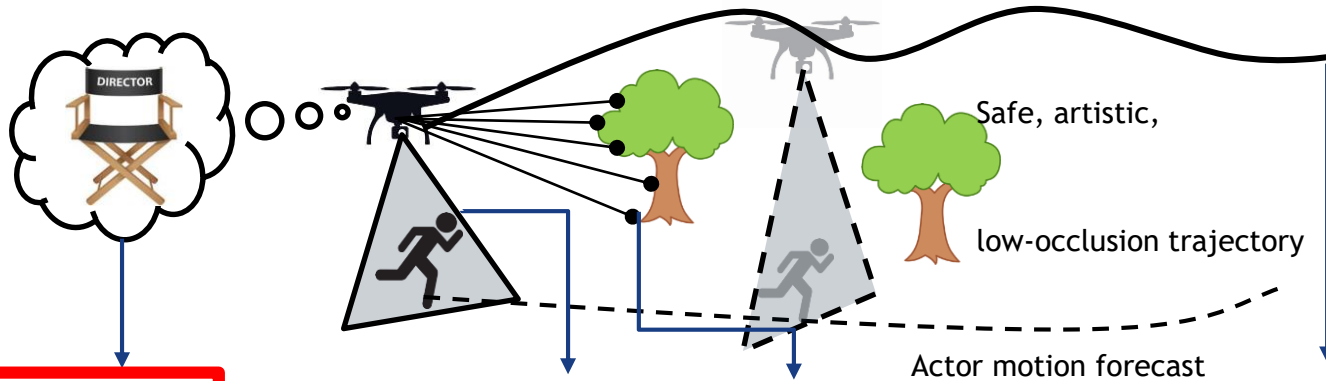
**Department of Engineering,
Aarhus University, Denmark**

May 2018

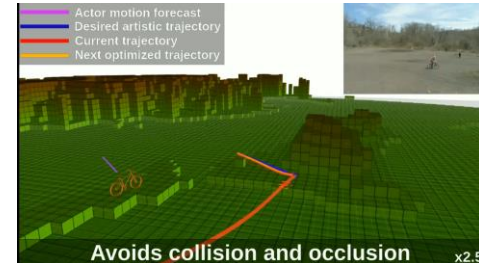
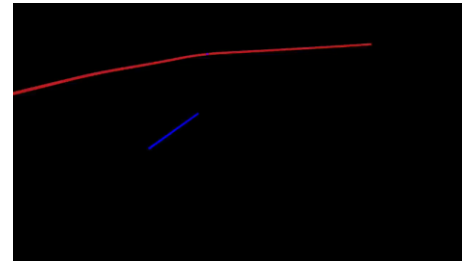
KNOWLEDGE TRANSFER BETWEEN



WHAT MAKES FILMING HARD?



Visual actor localization and motion forecasting



Optimization-based motion planner

AERIAL CINEMATOGRAPHY USING DRONES

Artistic reasoning

Visual detection

Mapping

Motion planning



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EVALUATING THE LEARNED ARTISTIC BEHAVIOURS



Table 14: Average normalized score of video clips between 0 (worst) and 10 (best).

	Average	Scene 1	Scene 2	Scene 3	Scene 4	Scene 5
Hand-crafted reward	8.2	10.0	5.3	9.3	7.7	8.7
Human reward	7.1	5.0	9.0	6.0	7.7	8.0
Back shot	3.8	4.0	4.7	4.3	4.0	2.0
Random	0.9	1.0	1.0	0.3	0.7	1.3

DRONE RACING

Exploiting Fast and Accurate Semi-Synthetic Image Generation
for Efficient CNN training Autonomous Drone Racing

Théo Morales, Andriy Sarabakha, Erdal Kayacan



ANOMALY DETECTION USING DRONES

UAV-AdNet: Unsupervised Anomaly Detection using Deep Neural Networks for Aerial Surveillance

Ilker Bozcan and Erdal Kayacan

Department of Engineering, Aarhus University, Denmark
Artificial Intelligence in Robotics Lab (AIRLab)



AARHUS UNIVERSITY



AARHUS
UNIVERSITY
DEPARTMENT OF ENGINEERING

29 NOVEMBER 2019
ARTIFICIAL INTELLIGENCE IN ROBOTICS GROUP

ERDAL KAYACAN
ASSOCIATE PROFESSOR



CHALLENGES IN DRONE TECHNOLOGY

State and parameter estimation in outdoor applications

Perception loops for autonomy

Navigation in cluttered environment

Perception action for swarms

Learning control for drones



erdal@eng.au.dk

<http://www.erdal.info>

<https://www.youtube.com/erdalkayacan>

<https://www.linkedin.com/in/erdalk/>



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