MORUS

Moving-Mass-based Adaptive VPC for ICE Powered Transportation Quadcopter

Tomislav Haus, Matko Orsag, Stjepan Bogdan

Laboratory for Robotics and Intelligent Control Systems – LARICS
Dept. of Control and Computer Engineering
Faculty of Electrical Engineering and Computing
University of Zagreb

Motivation:

❑ **to enhance response time and cut the cost of urgent UUV security missions by:**

- **shortening Unmanned Underwater Vehicle (re)deployment time**
- **eliminating the expensive ship and crew time from the mission budget**

HOW ? => *(Re)deploy an UUV by using an UAV*

Combine advantages from both;
***long autonomy of UUV** and*
speed and agility of UAV

larics.rasip.fer.hr

Croatian Army military facility, November 2017.

Croatian Army military facility, November 2017.

Croatian Army military facility, November 2017.

Croatian Army military facility, November 2017.

Propulsion system

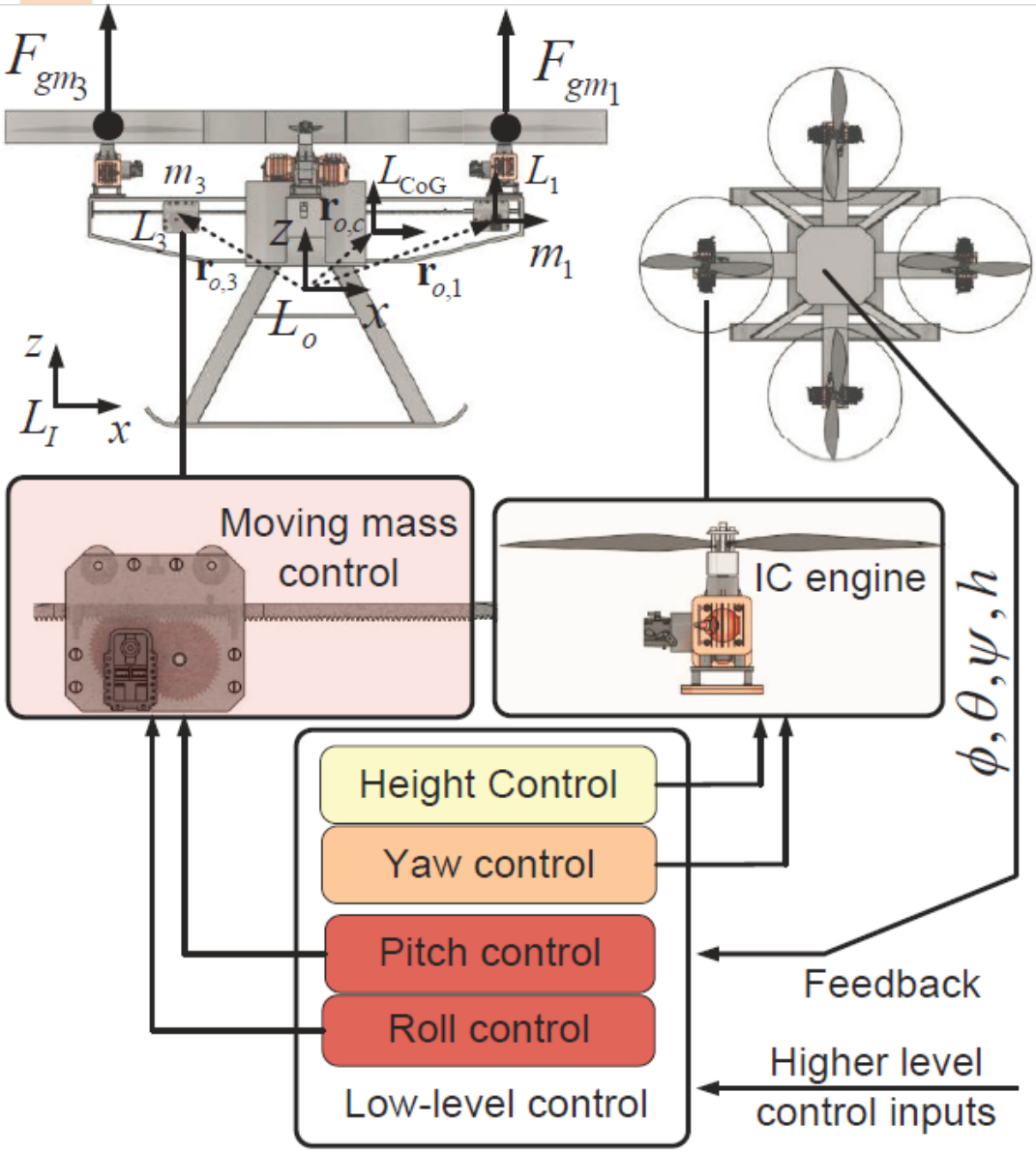
⇒ 4 internal combustion engines (2-stroke)
- DLE111 (11.2 HP @ 7,500 RPM, 25 kg thrust w 27x10 prop)

ICE dynamics

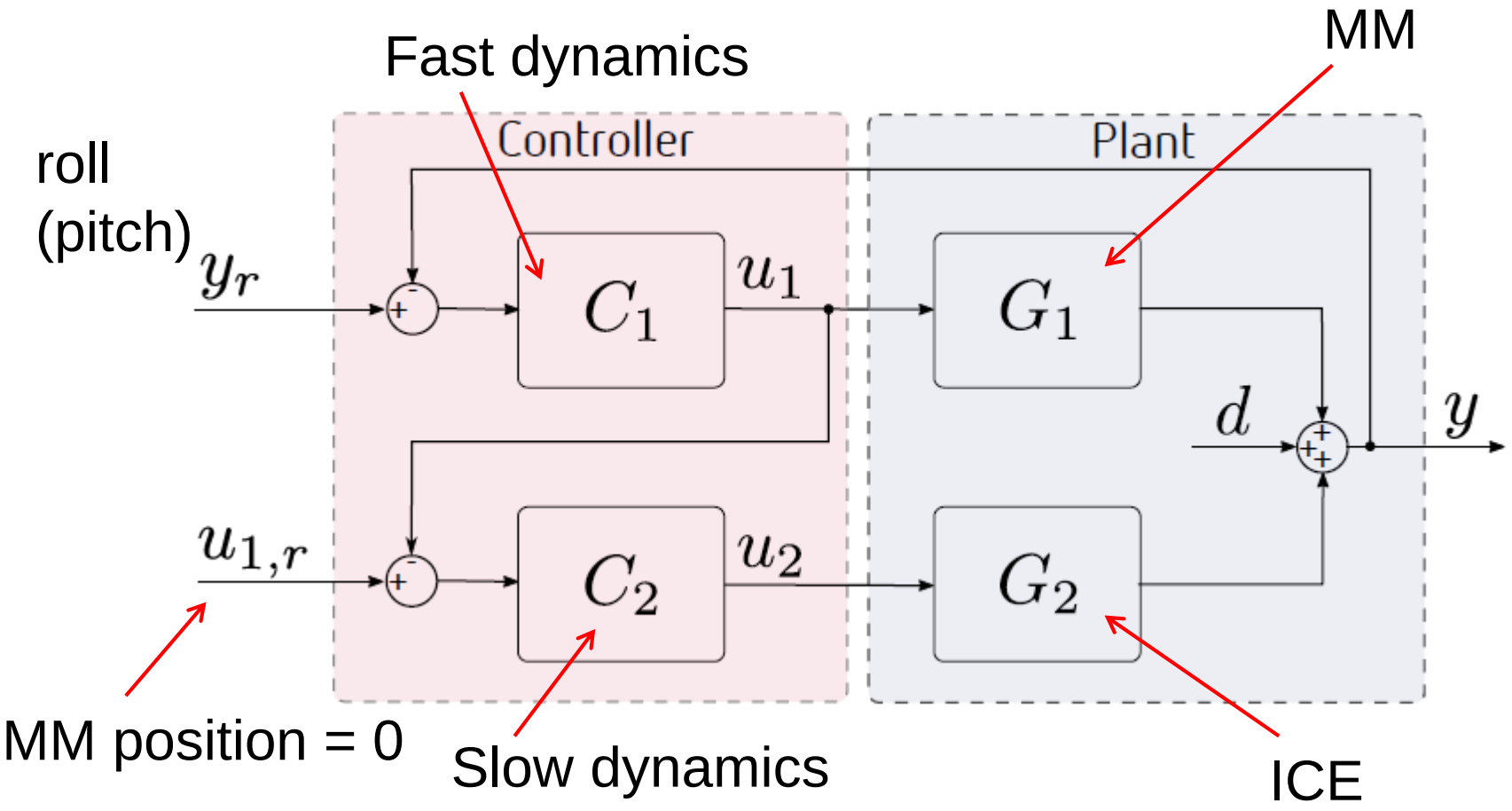
-Time constant ~ 200 ms
(el. mot. 15 - 50 ms)

Change the concept of UAV attitude control

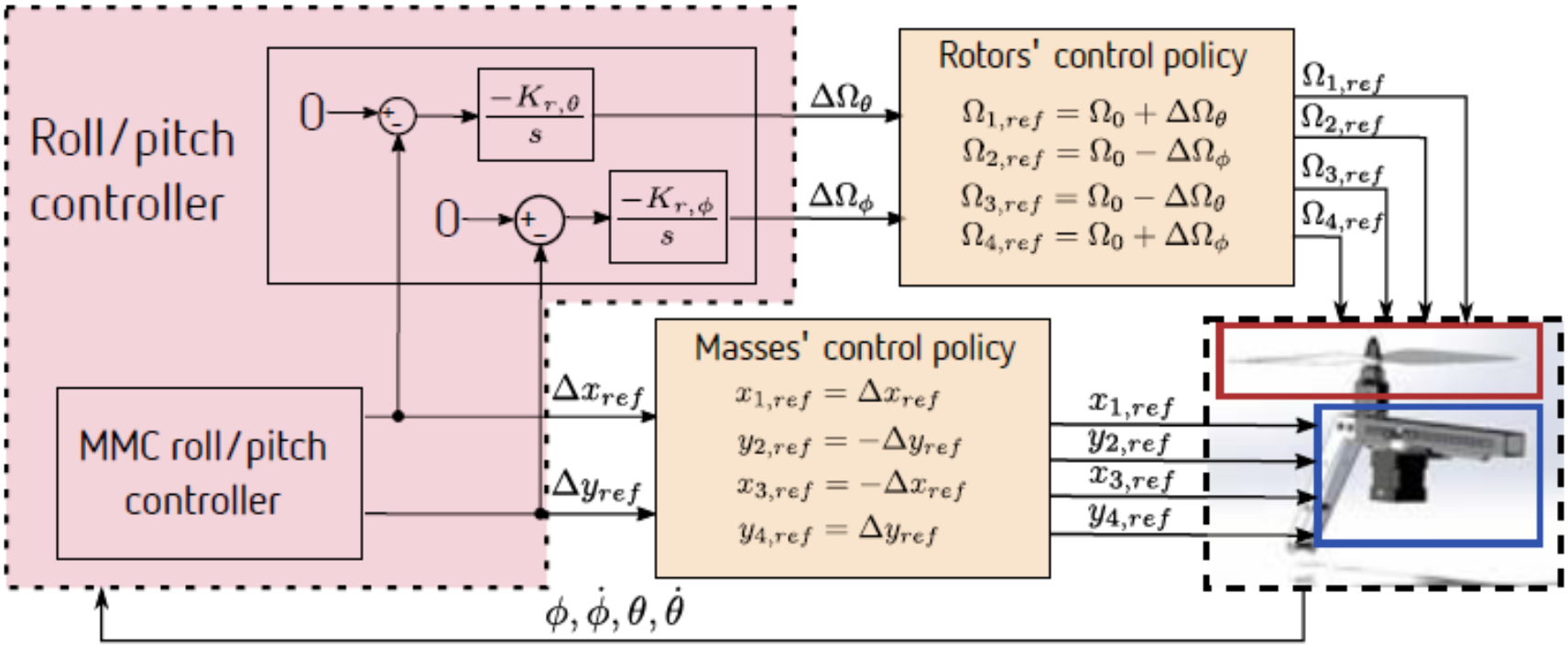
Moving Mass Concept (MMC)

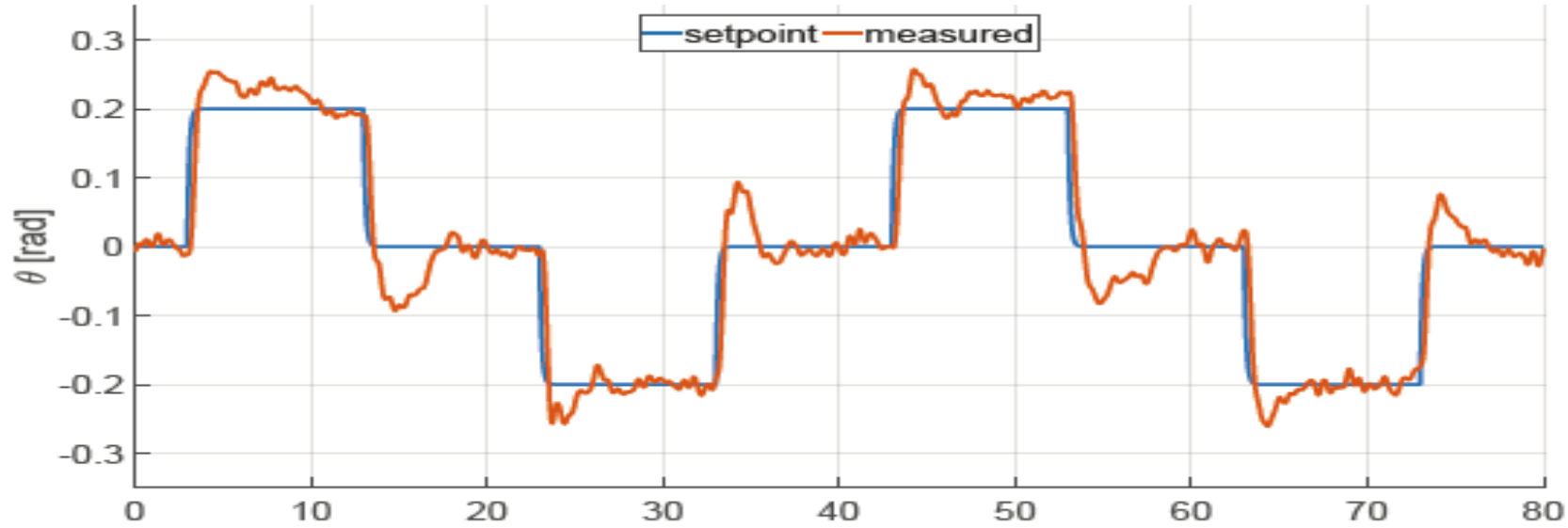

F_{gm_3}
F_{gm_1}
m_3
L_{CoG}
L_1
L_3
z
$\mathbf{r}_{o,o}$
m_1
$\mathbf{r}_{o,3}$
$\mathbf{r}_{o,1}$
L_o
x
z
L_I
x
Moving mass control
IC engine
ϕ, θ, ψ, h
Height Control
Yaw control
Pitch control
Roll control
Low-level control
Feedback
Higher level control inputs

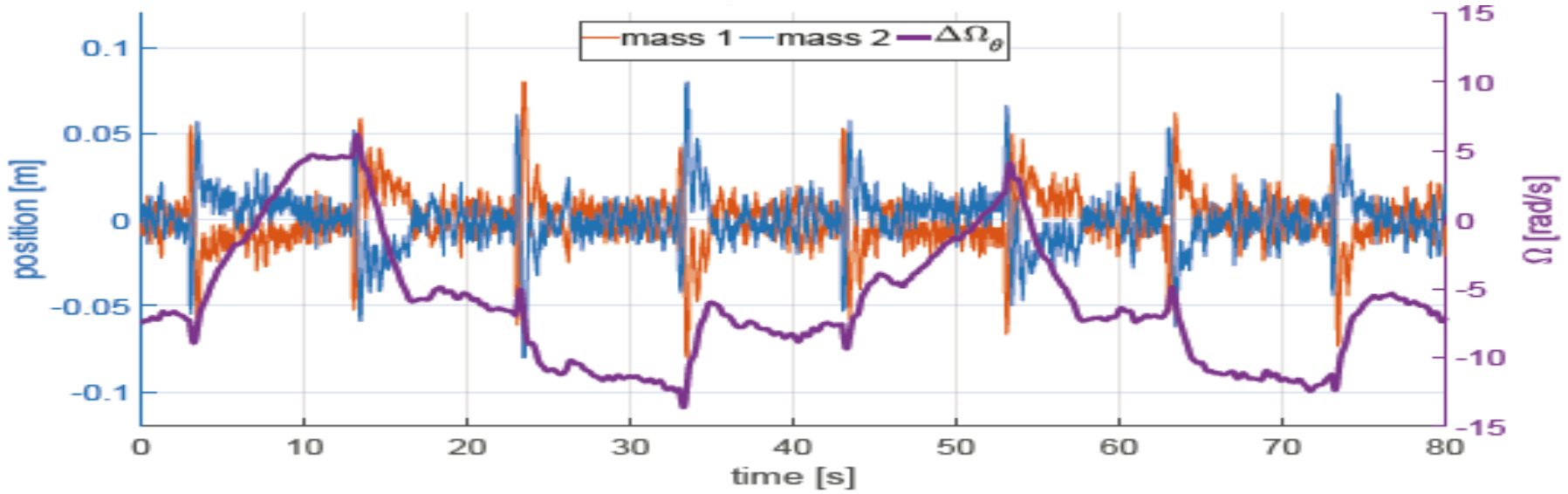
VPC (mid-ranging) structure

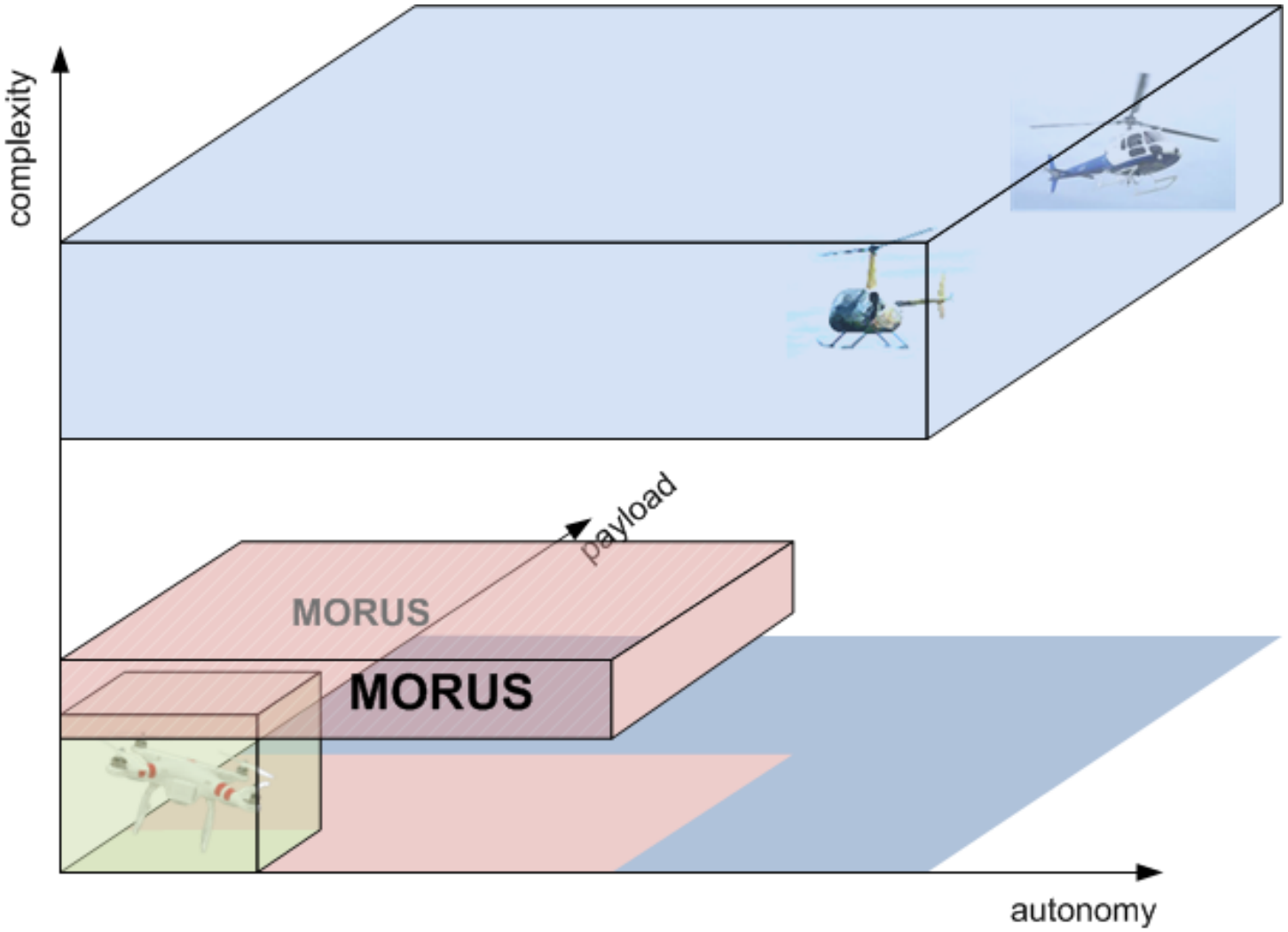


VPC (mid-ranging) structure
applied on MMC UAV




setpoint
measured
θ [rad]
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
0
10
20
30
40
50
60
70
80


mass 1
mass 2
$\Delta\Omega_\theta$
position [m]
0.1
0.05
0
-0.05
-0.1
Ω [rad/s]
15
10
5
0
-5
-10
-15
0
10
20
30
40
50
60
70
80
time [s]


complexity
payload
MORUS
MORUS
autonomy





Thank you.

LARICS