Shooting, Driving and Strategy

by: Tech United Eindhoven

@TechUnited

techunited@tue.nl

www.techunited.nl

Tech United Eindhoven

TU/e Technische Universiteit Eindhoven University of Technology

Tech United MSL

De TURTLEs

Tech
United
RoboCup
Team
Limited
Edition

Foto: Bart van Overbeeke

Shooting, Driving and Strategy

Shooting

Chiel Kengen
Yanick Douven
Harrie van de Loo

Driving

Wouter Houtman
Johan Kon
Milan Haverlag

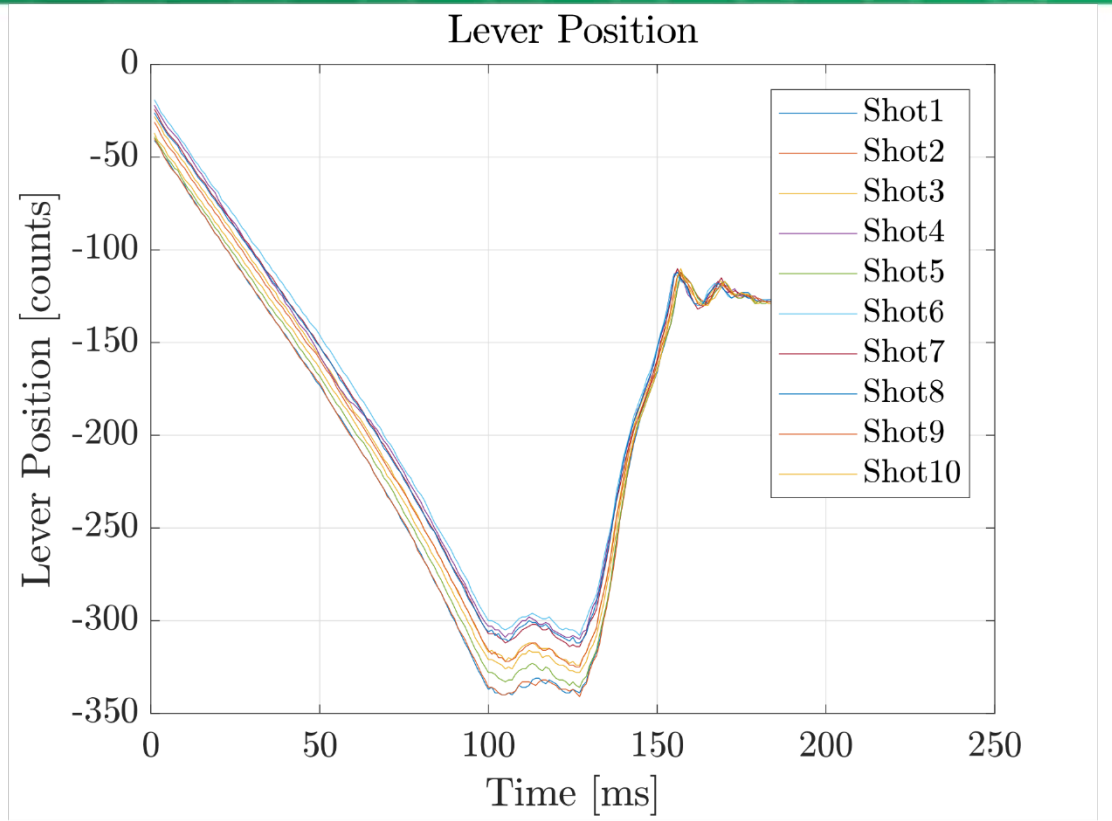
Strategy

Jorrit Olthuis
Wouter Aangenent
Ruben Beumer

Lever Angle Variation

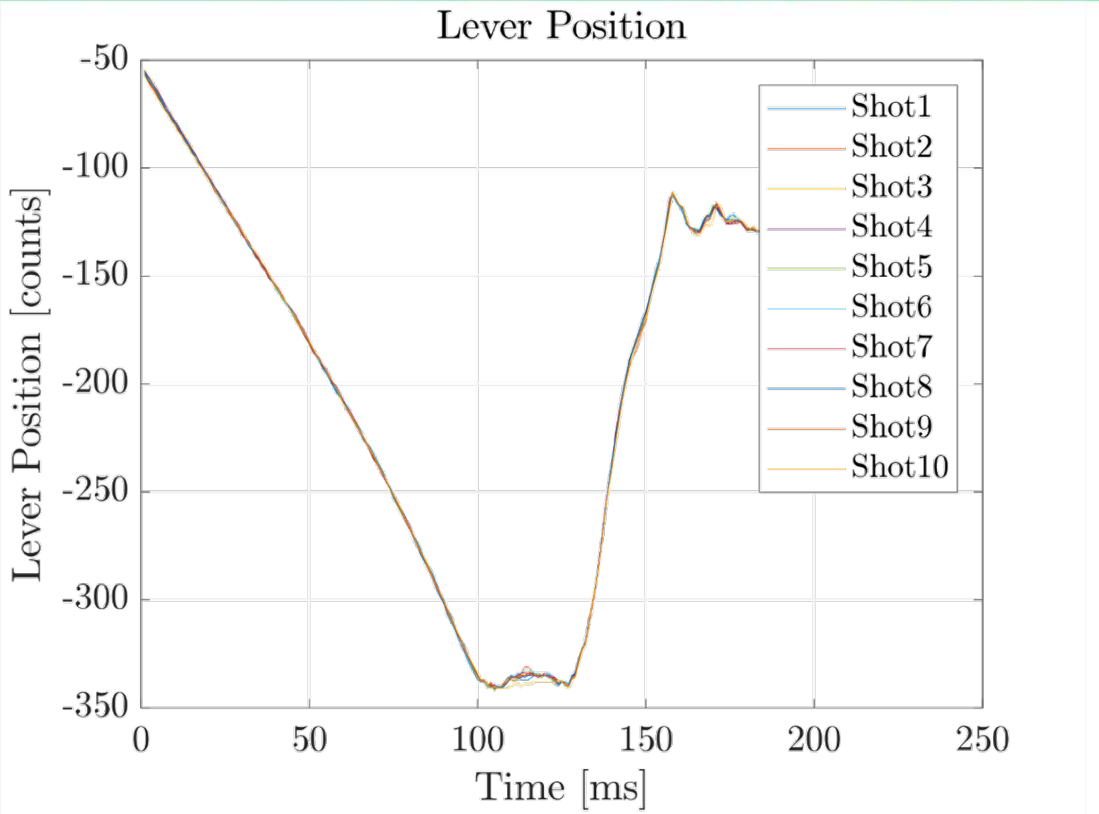
- Variation in starting position of lever.
- This correlates to ball exit velocity.

*When the lever starts at the **lowest** position, it gets **more time** to build op velocity before hitting the ball: **harder** shot.*



Lever Angle Variation

- Variation in starting position removed by manually forcing lever.
- Encoder shows more consistent shots, result on field is smaller 0.3 $[m]$.



Lever Angle Variation

usual practice

moving lever backwards

Lever Angle Variation

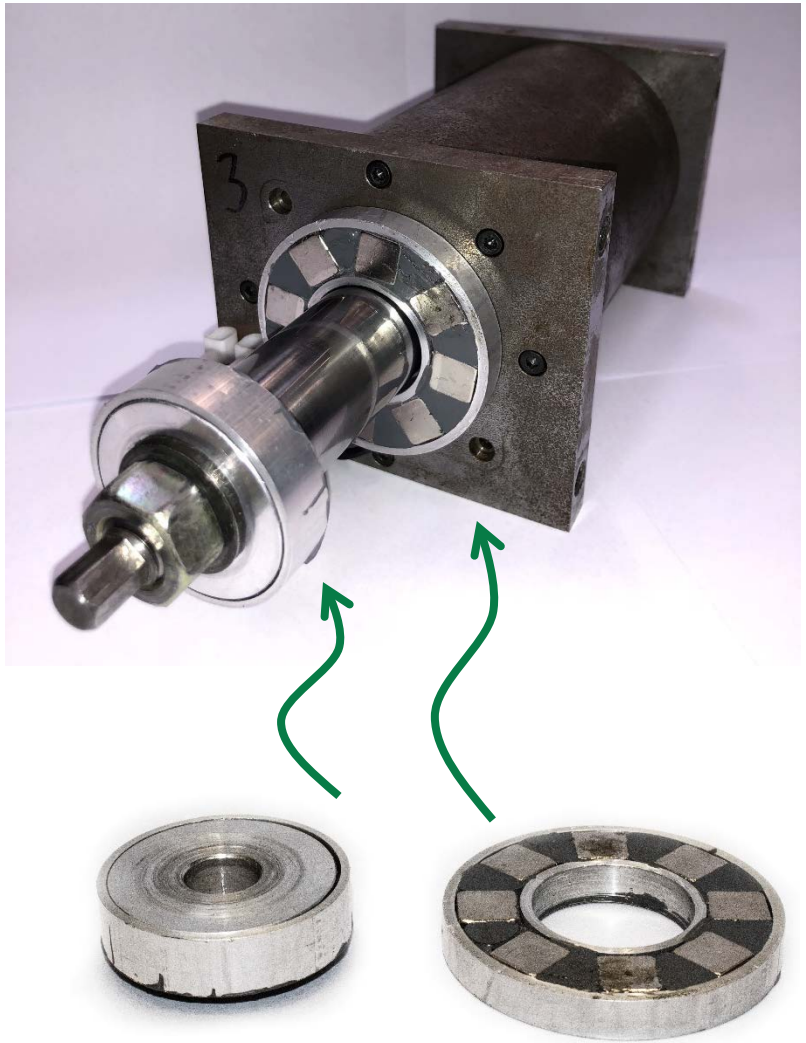
What causes this lever position variation?

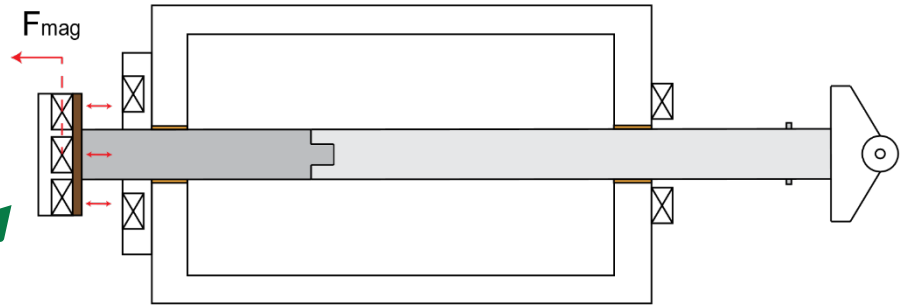
- *Friction in bearings when falling back*
- *Heavy braking and spinning of the TURTLE cause lever to move*

Requirement: (among others)

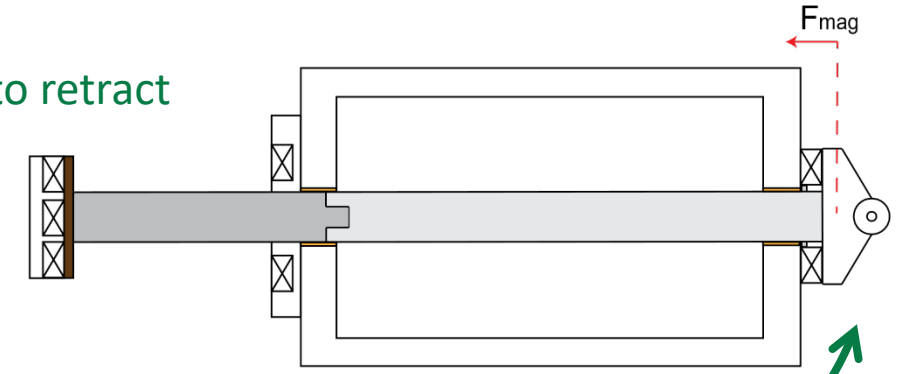
- *No significant decrease in shooting power.*

Designed System



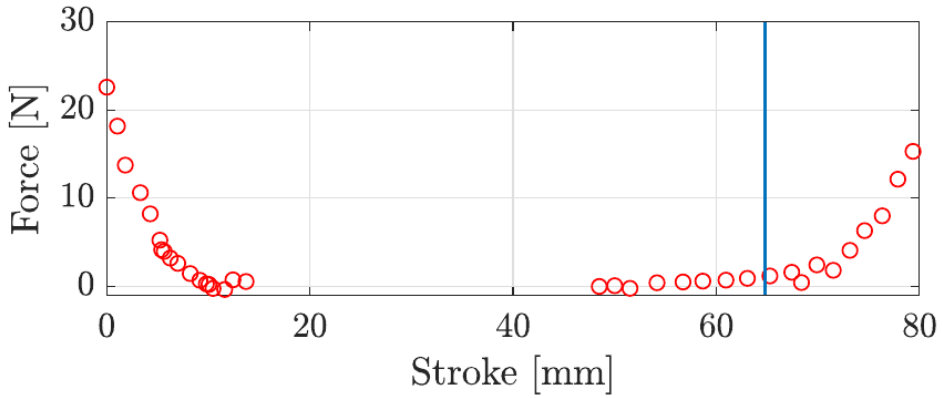


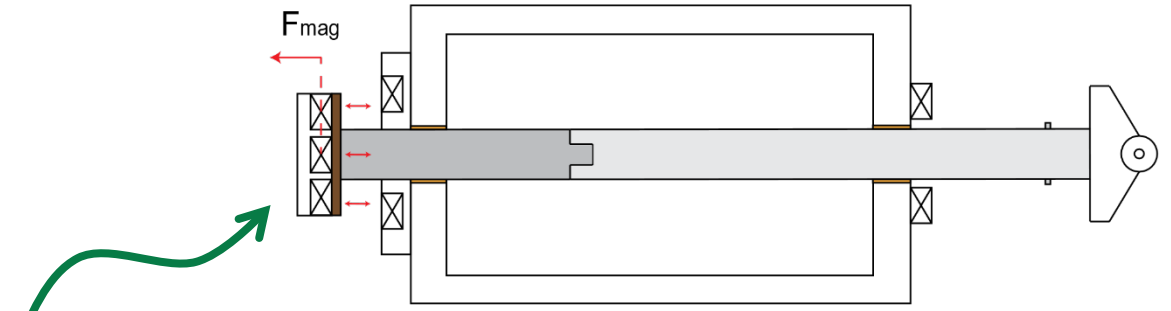
Repelling Magnets: to retract



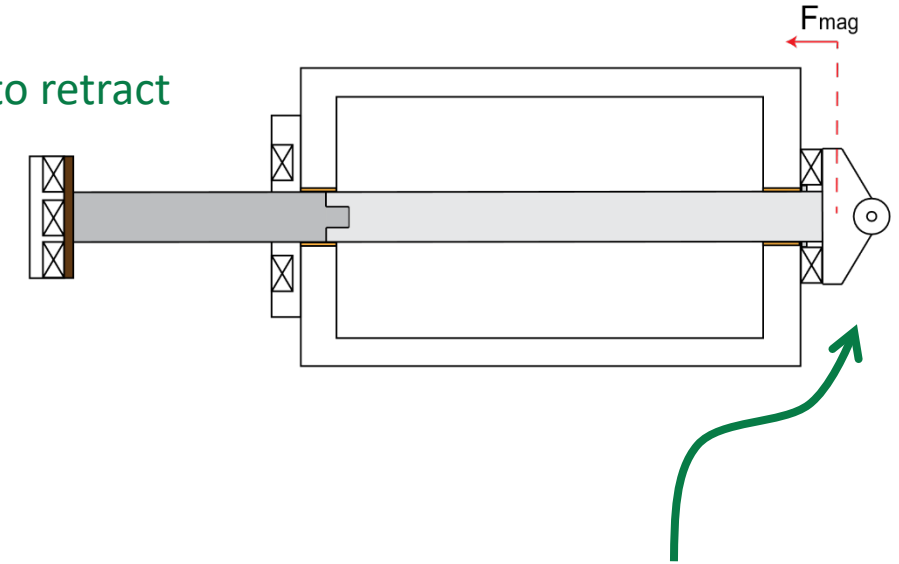
Attracting Magnets: to hold position

Designed System





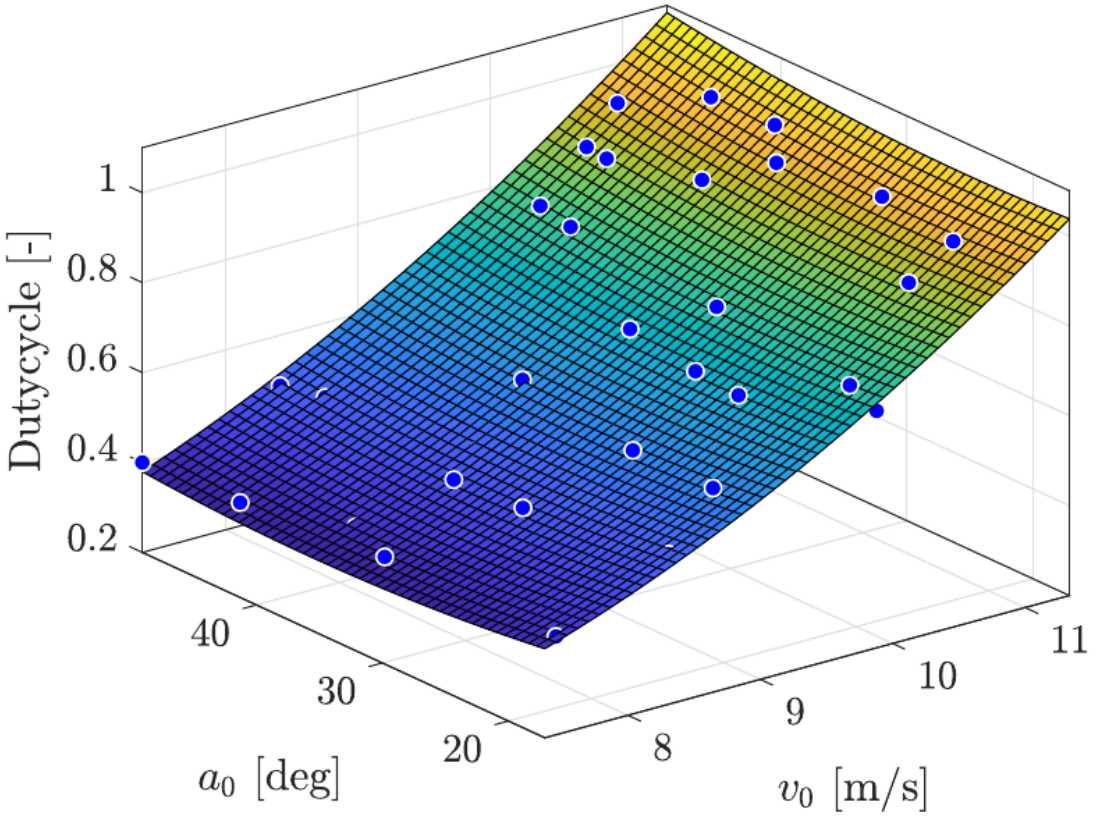
Repelling Magnets: to retract

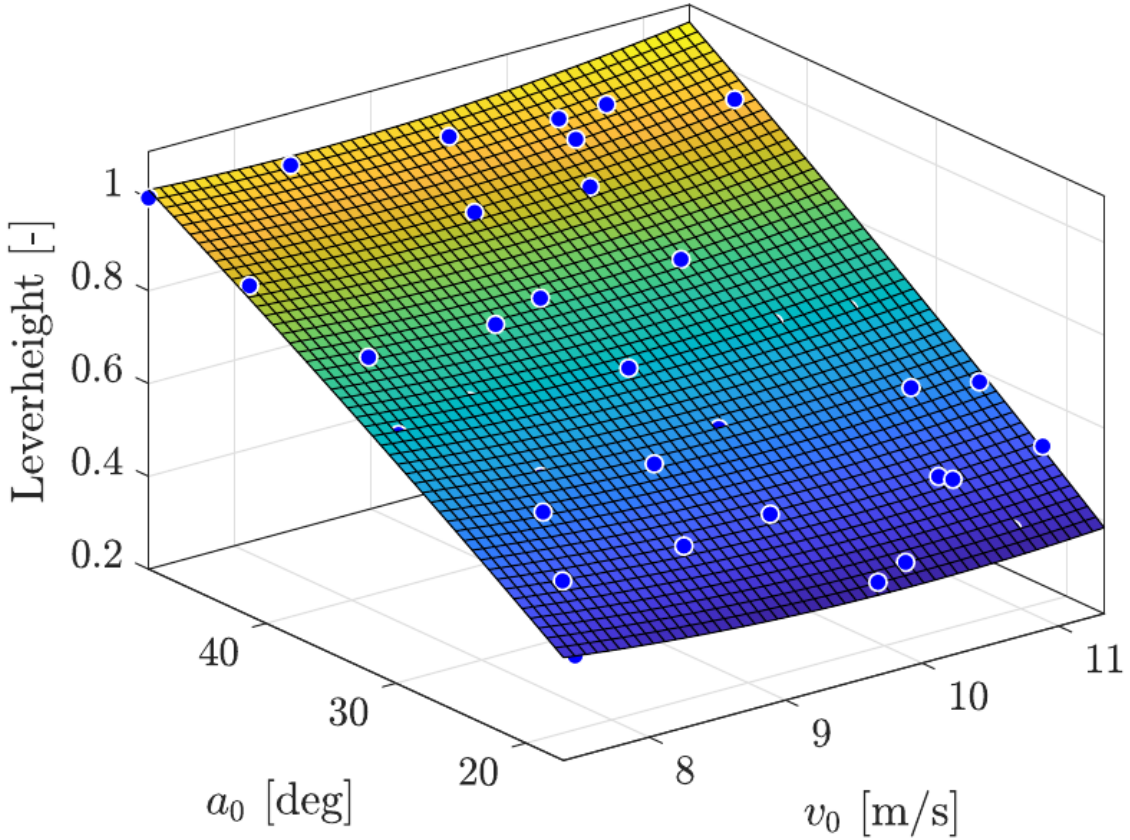


Attracting Magnets: to hold position

Shooting Mapping using Kinect V2

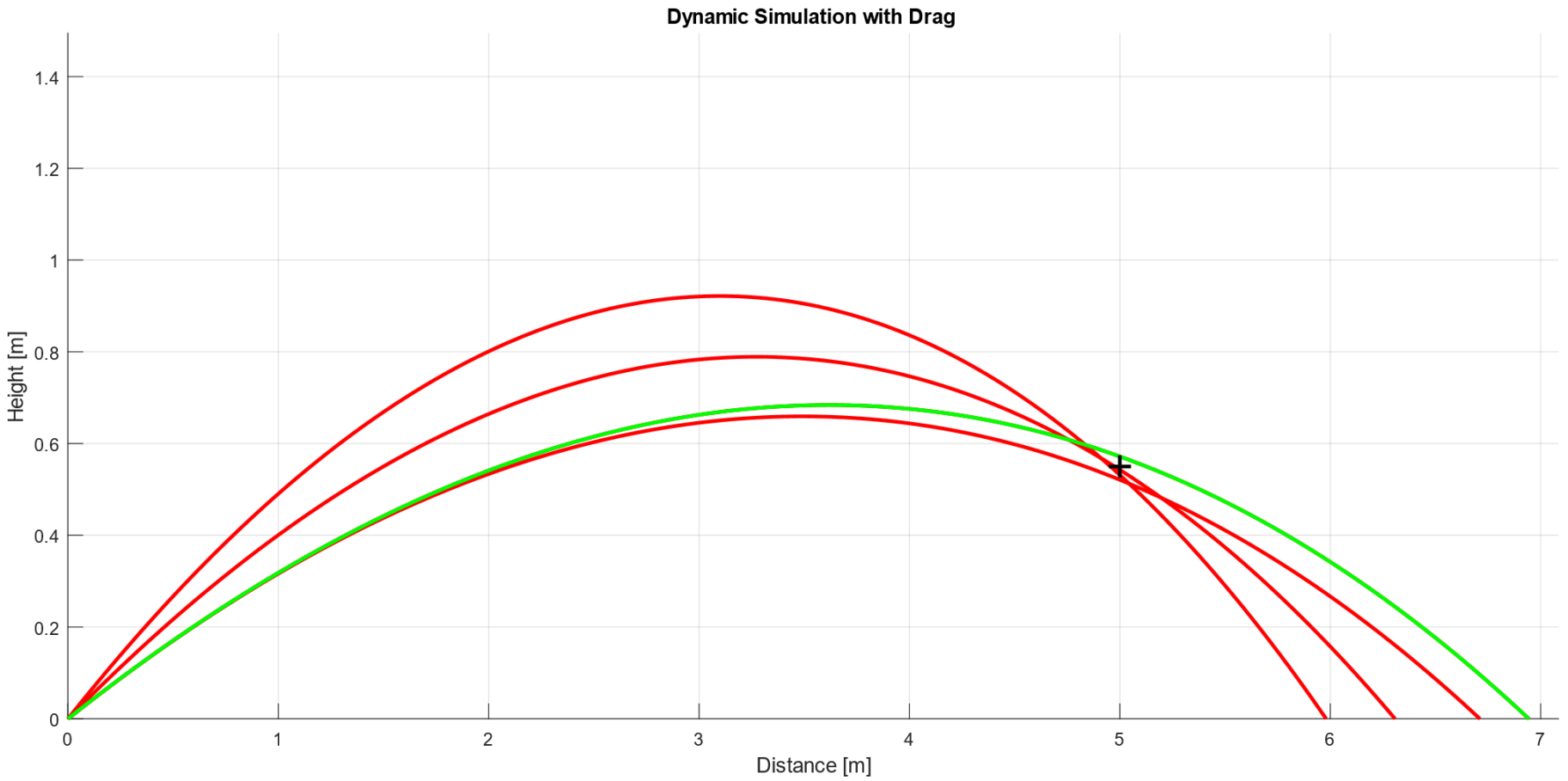
What about calibration?





Shooting Strategy to decrease variation

Extra Idea: multiple ways to hit target (+), find the one least sensitive to variations (and fast).



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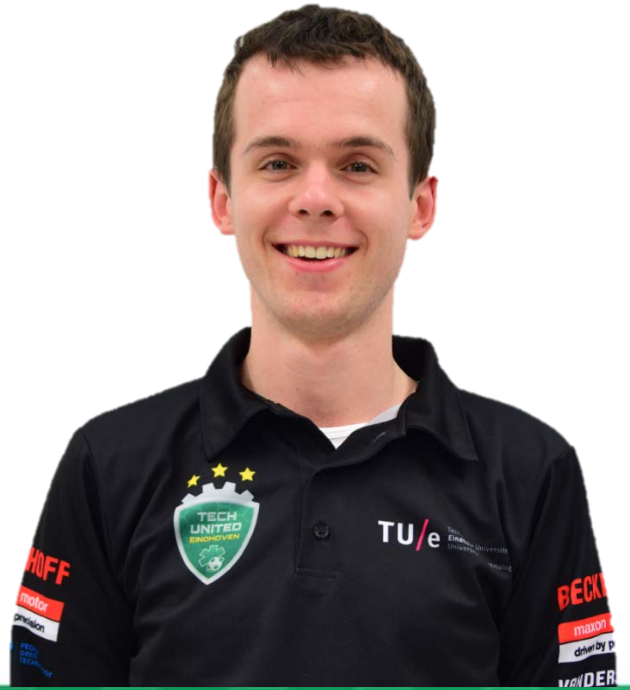
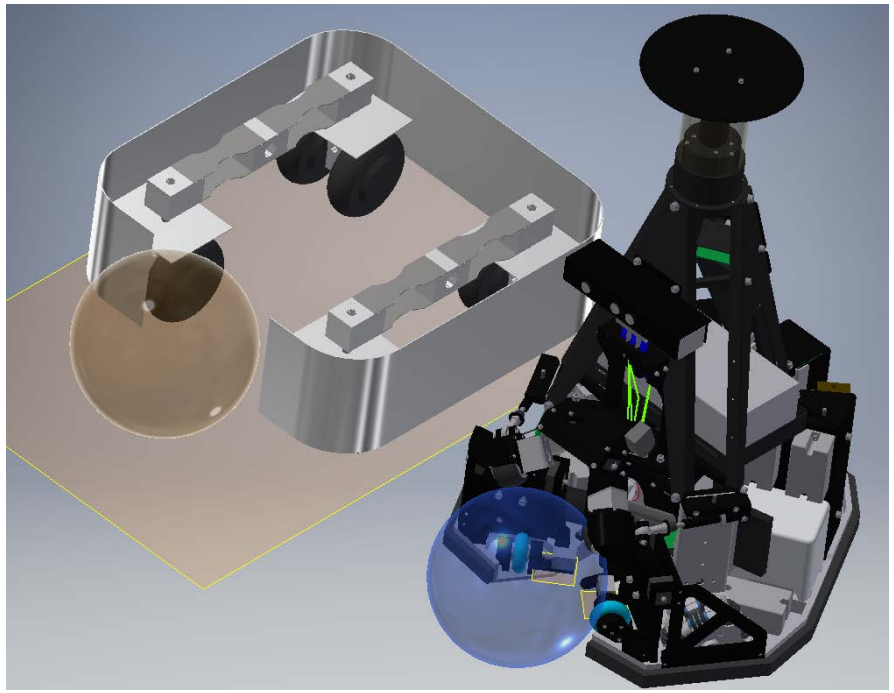


8-wheeled Platform: Short Description

- 4 wheel units having 2 wheels each
- Objective:
  - Apply power in preferred direction
  - Increase in Velocity & Acceleration



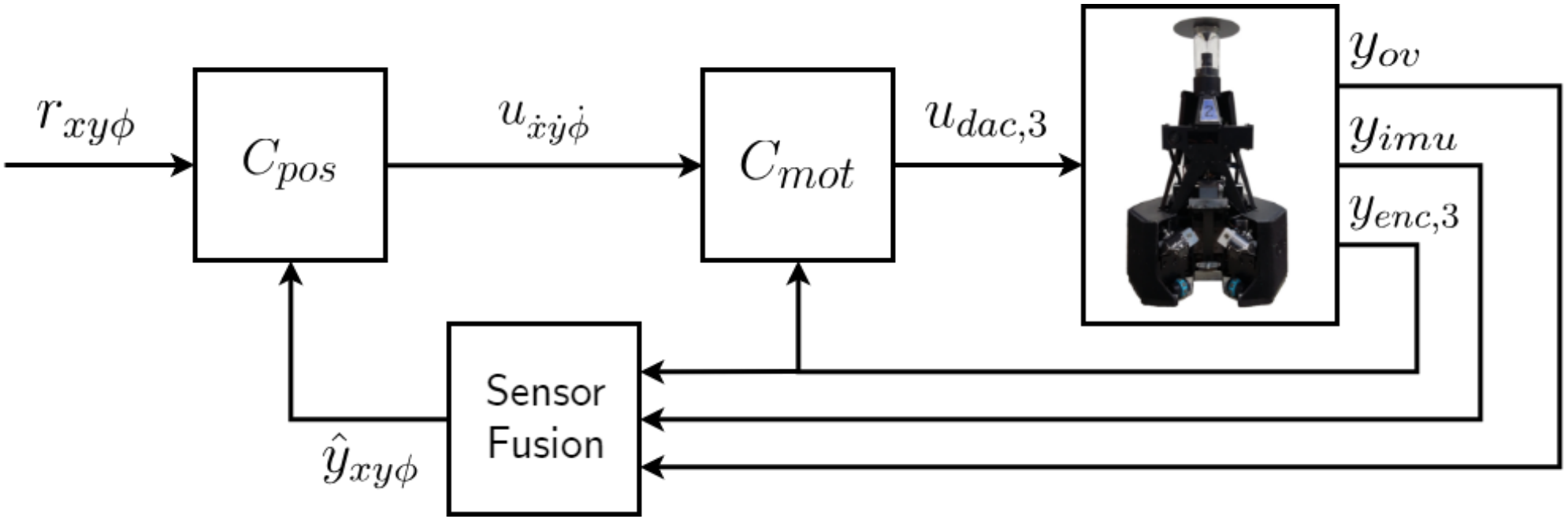
Cascaded Position Control

Position Loop

- reference global platform position: $r_{xy\phi}$
- feedback signal: $\hat{y}_{xy\phi}$

Motor Control Loops

- reference local platform velocity: $u_{\dot{x},\dot{y},\dot{\phi}}$
- control signal: $u_{dac,3}$
- feedback signal: $y_{enc,3}$

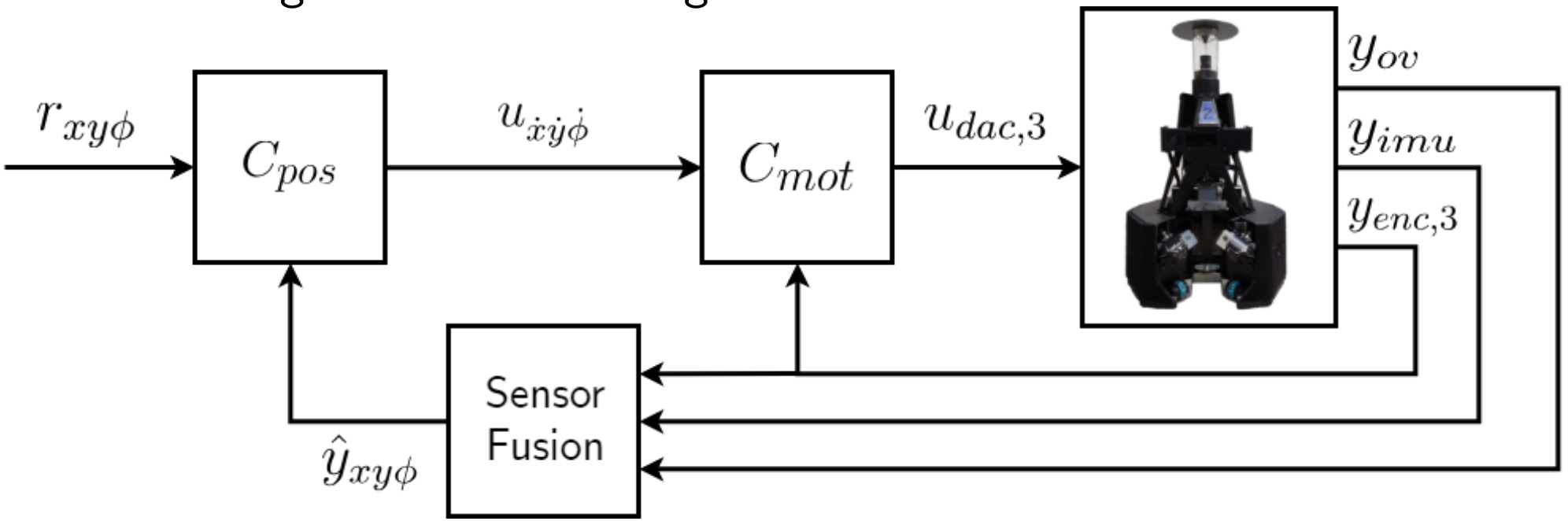


Cascaded Position Control

Sensor Fusion

- inputs: y_{ov}, y_{imu} and $y_{enc,3}$
- outputs: $\hat{y}_{xy\phi}$

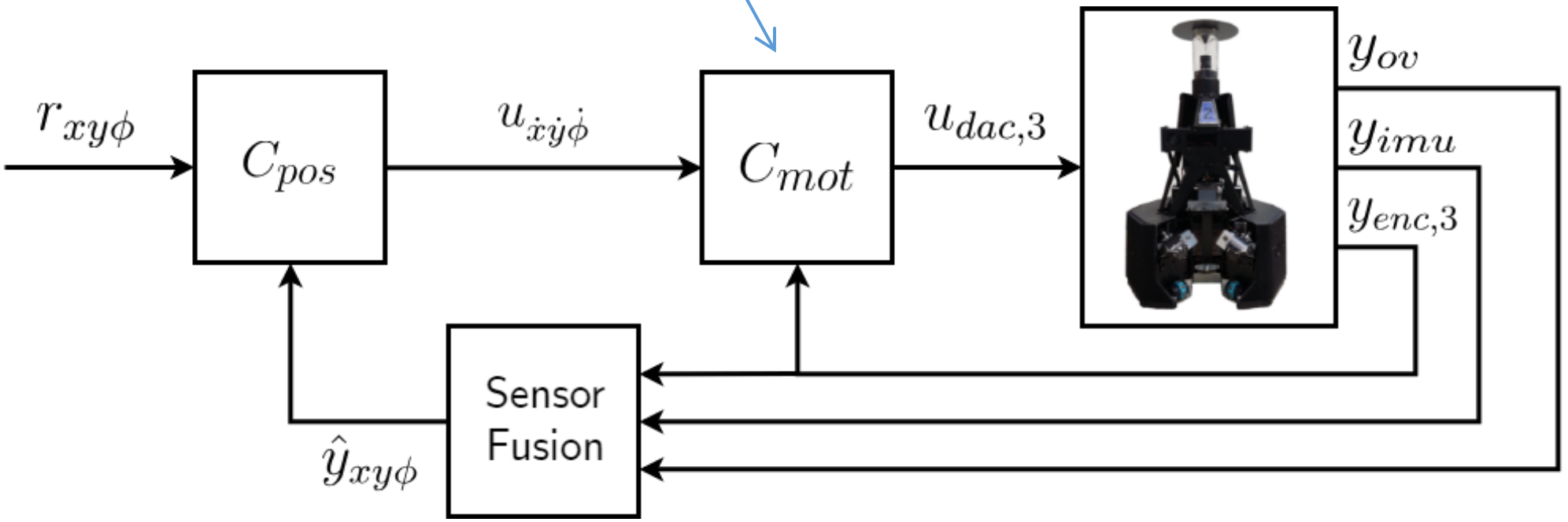
- Presented Last Year during Scientific Challenge



Cascaded Position Control: 8-wheeled platform

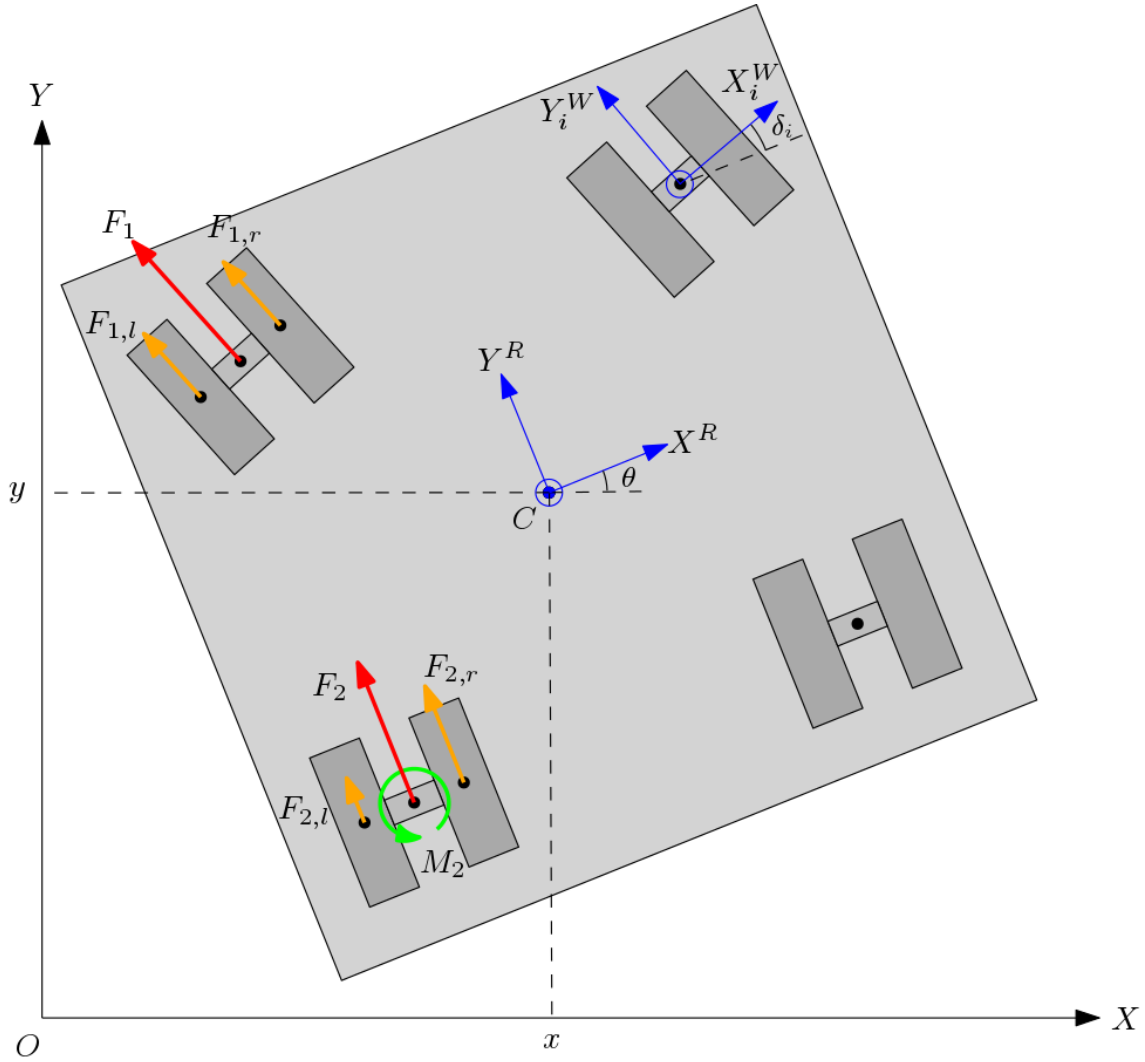
- Assumption: holonomic → replace C_{mot}

  Valid?

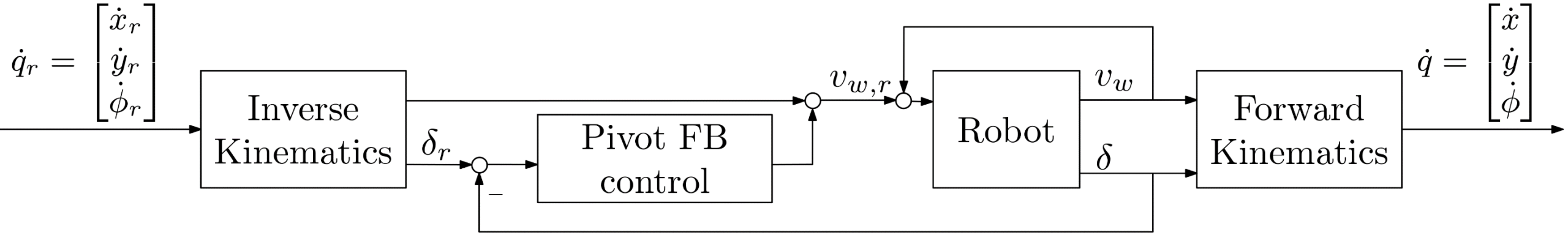


8-wheeled platform: Definitions

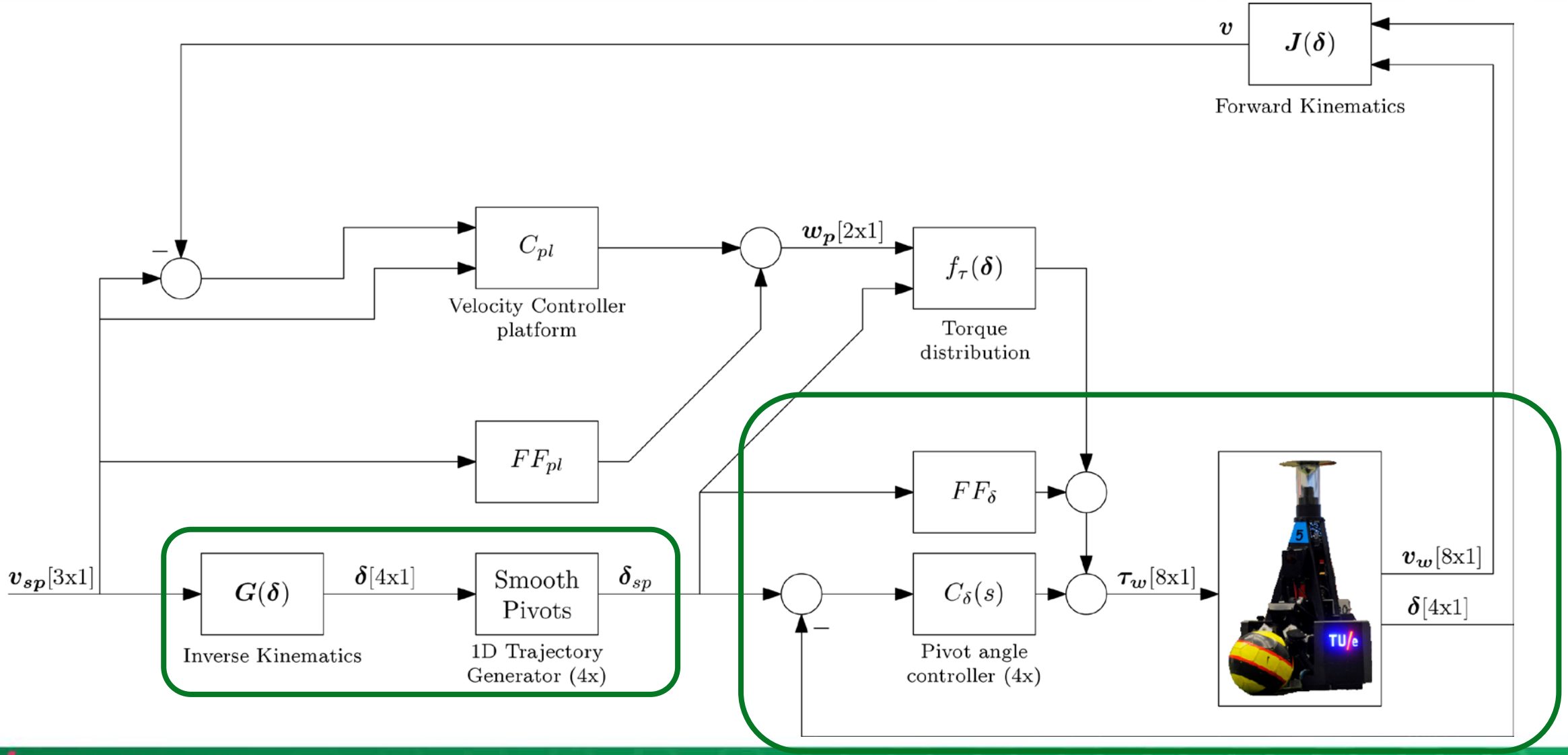
- Platform position: X^R, Y^R, θ
- Position of wheel i: X_i^W, Y_i^W, δ_i
- Zero caster offset



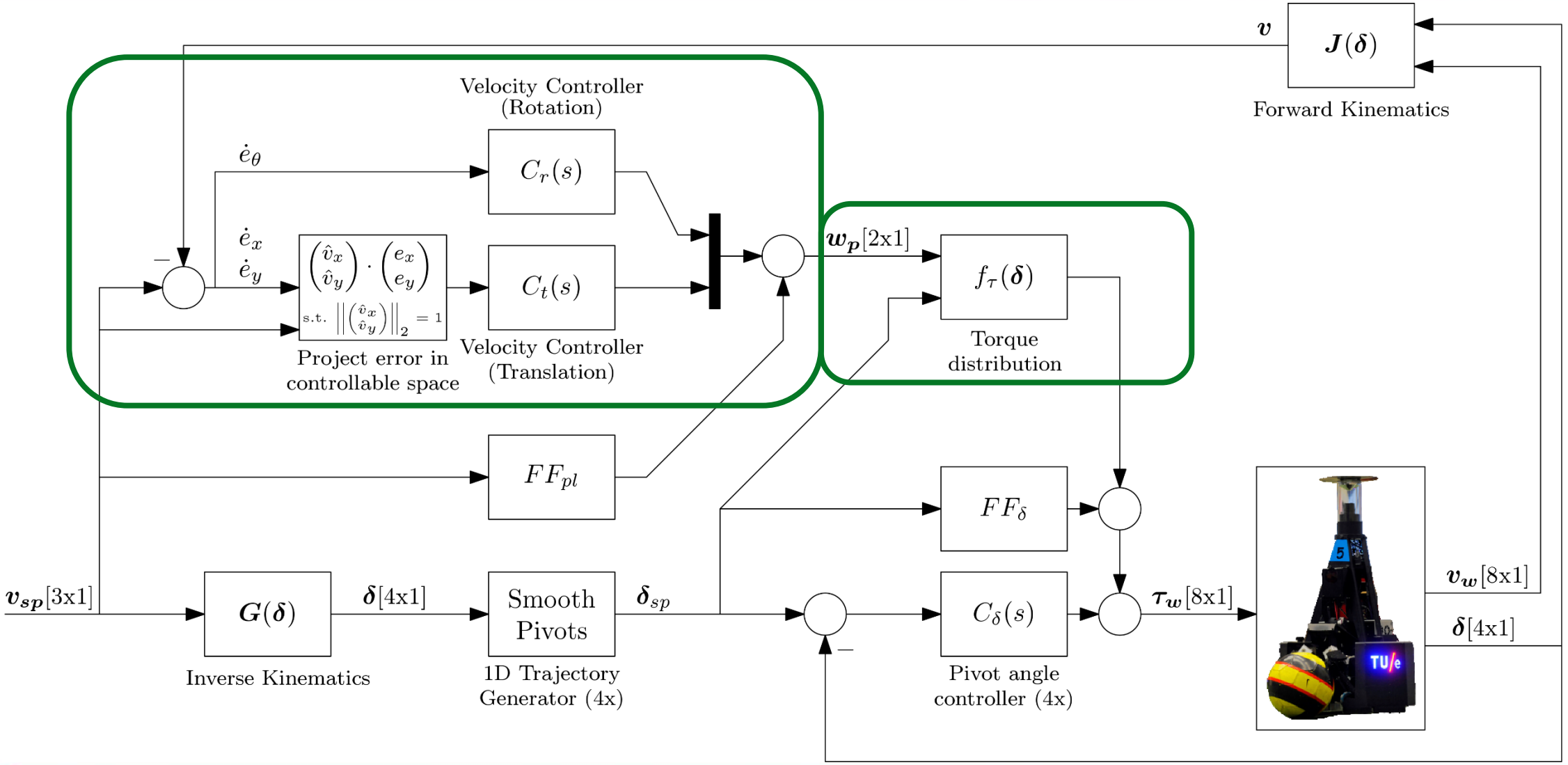
Last Year: Kinematic Control



8-wheeled Platform: Control Architecture

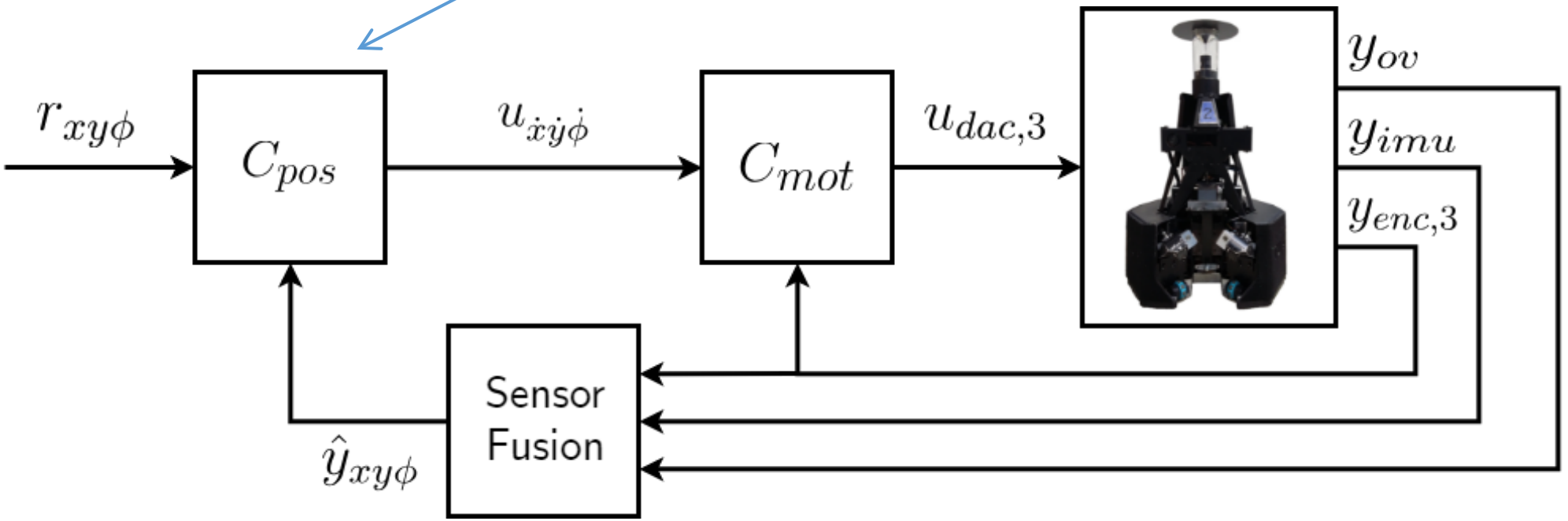


8-wheeled Platform: Control Architecture

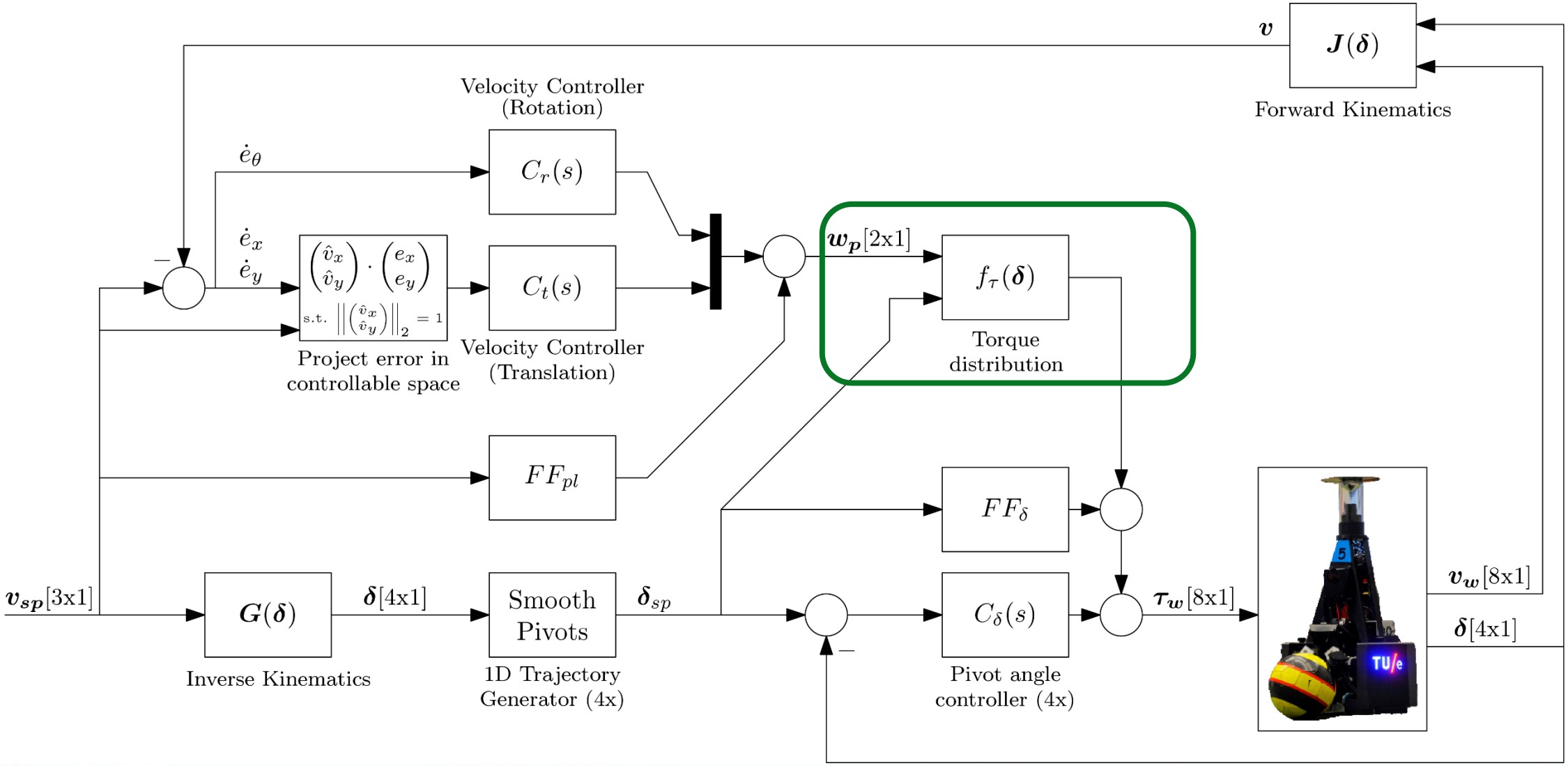


Outlook: Accurate Positioning -> Relevant Parameters?

- Again: When is platform holonomic? Now, consider C_{pos}
  - Driving vs. Low Velocity -> $\left\|u_{\dot{x},\dot{y},\dot{\phi}}\right\|_2 \approx 0$



Outlook: Torque Distribution & Slip



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Configurable strategy

Goals

- Adapt strategy per opponent
- Organise strategy more logically
- Reduce learning curve
- Improve code reuse
- Reduce hesitant behaviour

Solution

- STP framework
  - SSL
- Set of plays
  - Roles
  - Tasks
  - Preconditions
  - Invariants

State	TURTLE 1	TURTLE 2
1	Position	Position
2	Intercept ball	Position
3	Give pass to 2	Receive pass
4	Idle	Shoot at goal

C.K.M. de Koning, J. P. Mendoza, M. Veloso and M.J.G. van de Molengraft, *Skills, tactics and plays for decentralized multi-robot control in adversarial environments*.

Challenges

- All strategy is predetermined
- No choices possible during play

State	TURTLE 1	TURTLE 2	TURTLE 3
1	Position	Position	Position
2	Intercept ball	Position	Position
3	Give pass	Receive pass	Receive pass
4	Idle	Shoot at goal	Shoot at goal

Improvement

- Allow choice
  - During execution
  - Existing tasks
- Hesitation

State	TURTLE 1	TURTLE 2	TURTLE 3
1	Position	Position	Position
2	Intercept ball	Position	Position
3	Give pass	Receive pass / position	Receive pass / position
4	Idle	Shoot at goal / position	Shoot at goal / position

Thank you for your attention!

@TechUnited

@Wouter_Kuijpers

techunited@tue.nl

www.techunited.nl

Tech United Eindhoven

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Common Simulator

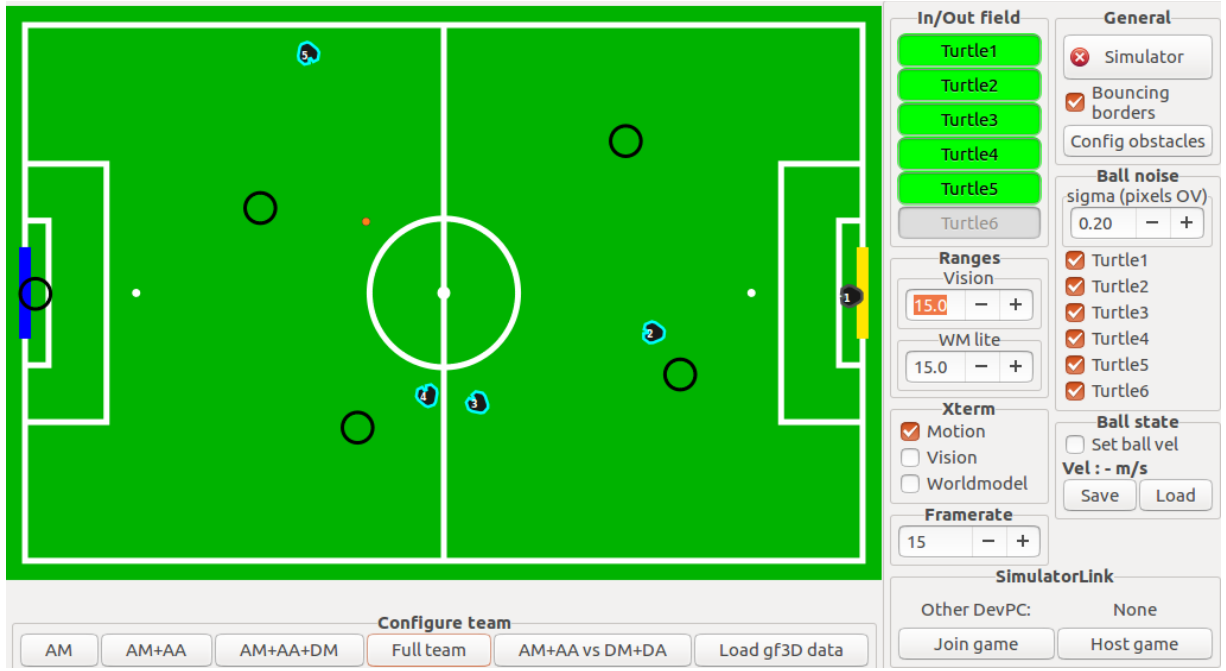
Current Simulator

Testing our **strategy** versus static obstacles.

MSL Common Simulator

Testing our **strategy** versus smart opponents.

*"The act of simulating something first requires that a model be developed; this model represents the **key** characteristics, behaviors and functions of the selected physical or abstract system or process." – Wikipedia*



Key characteristics

1. positions (velocities)
2. dribbling,
3. Scrums.