Universidad del País Vasco
Euskal Herriko Unibertsitatea

Benjamín Tapia (ESR11)

Multi-sensor fusion based adaptive control system for robotic physical interaction tasks

6/6/24

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Aitziber Mancisidor

EUROPEAN TRAINING NETWORK ON
MONITORING LARGE-SCALE COMPLEX SYSTEMS
MOIRA

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index

1. Proposal
2. Implementations
3. Current Work
4. Conclusions and next steps

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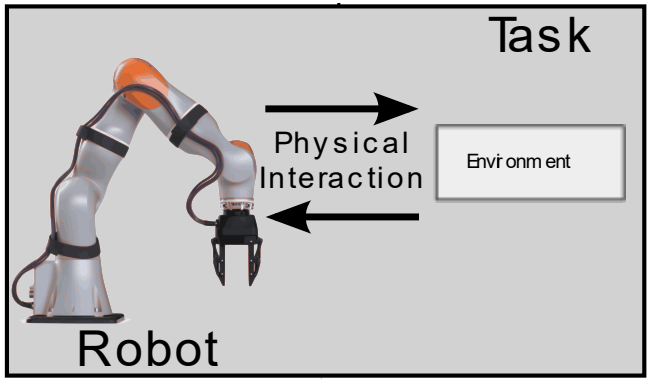
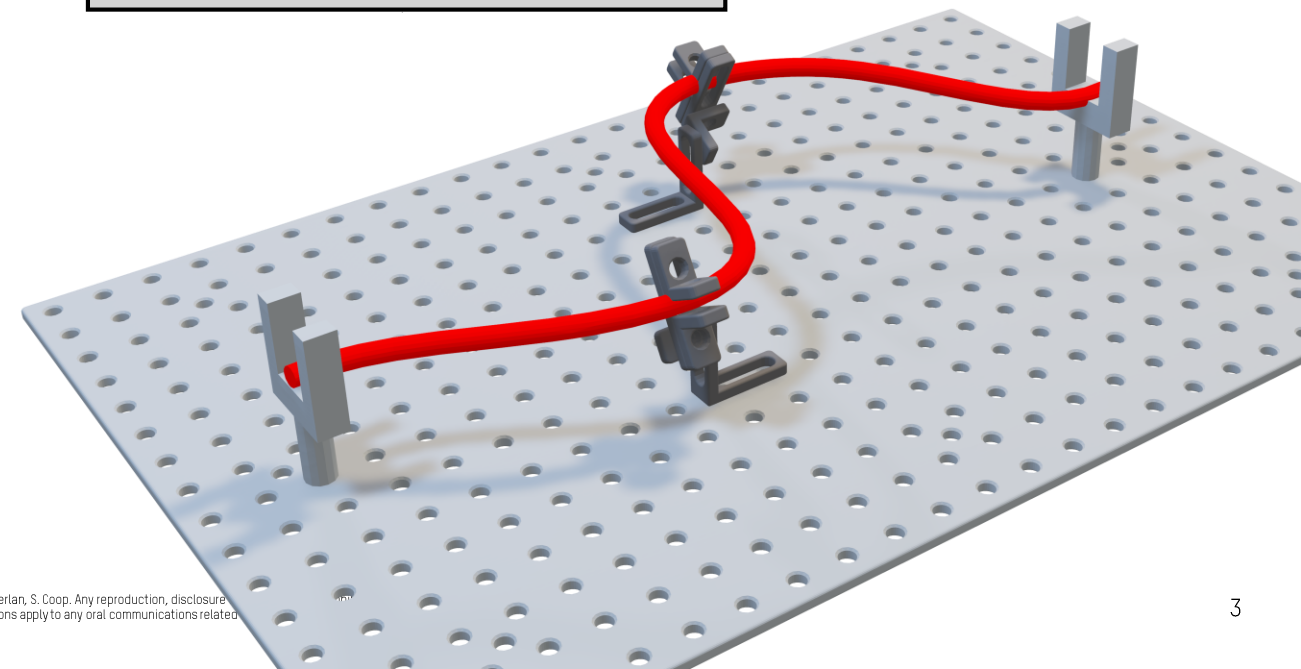
Disassembly
Of flexible elements



- ***Use case***
  - Disassembly Of flexible elements
- ***Challenges***
  - Unstructed Environments
  - Uncertainities
  - System performance
  - System components security
  - Required Force



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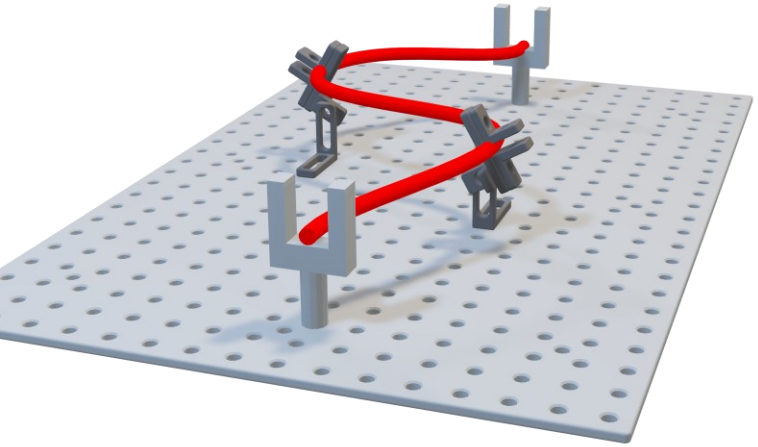
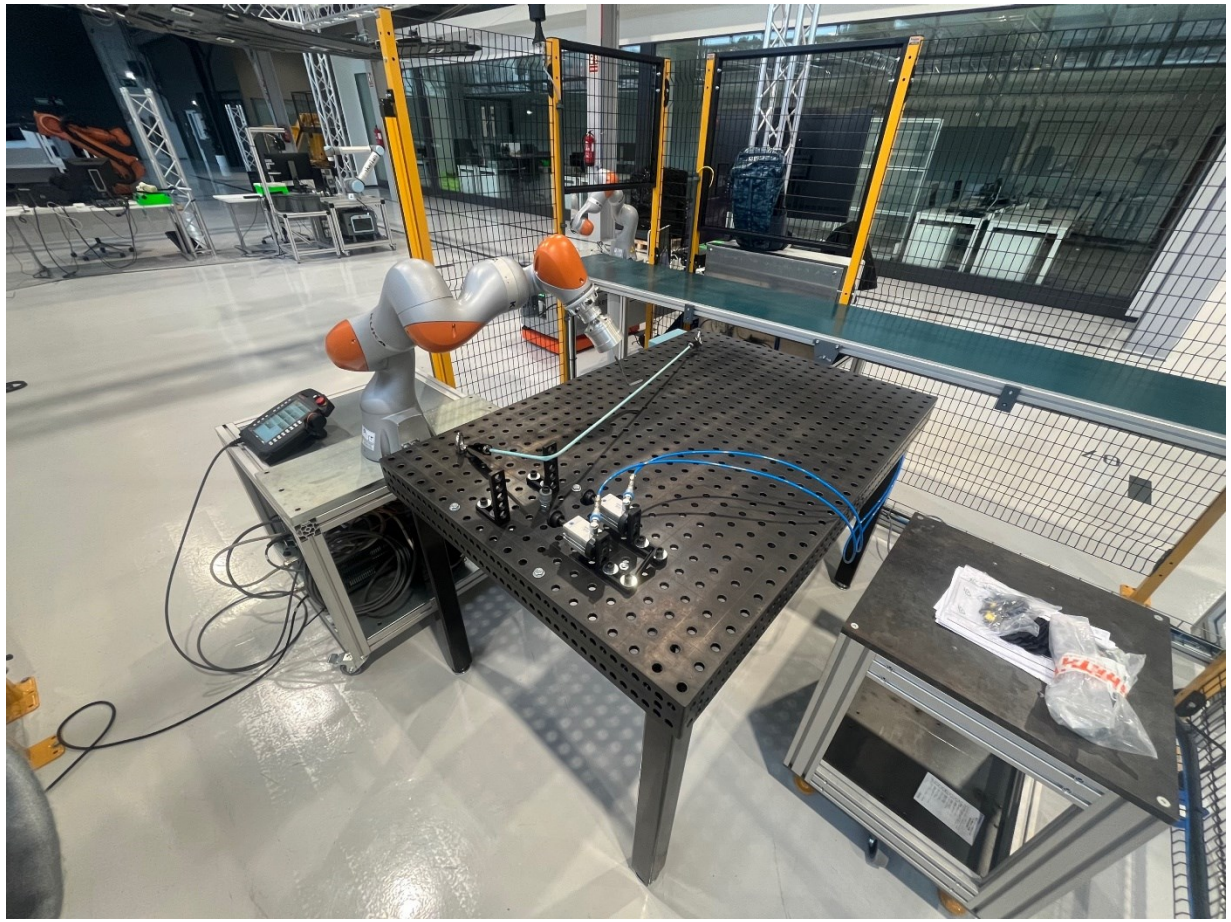
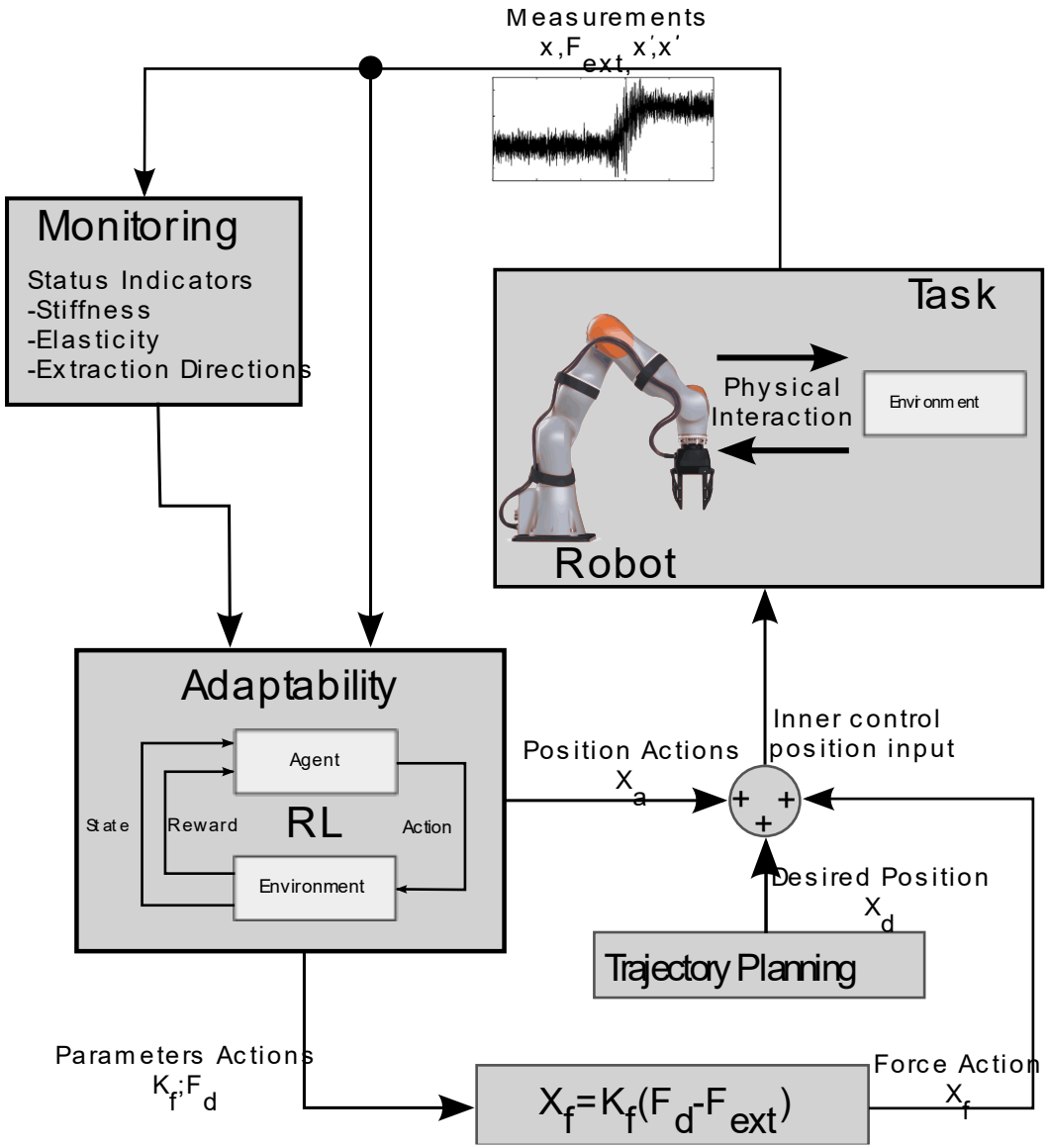
1. Proposal





Validation Environment

Proposal.



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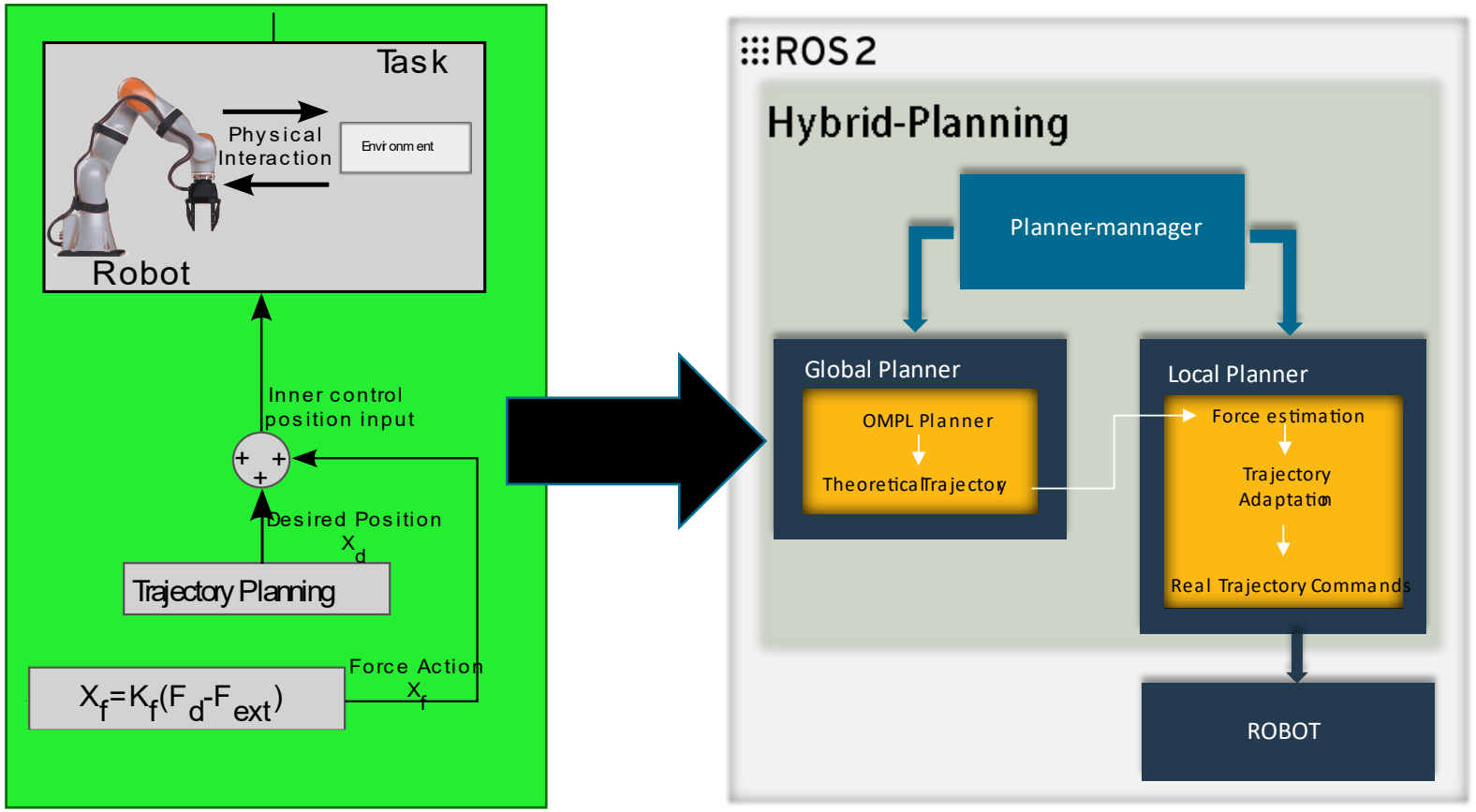
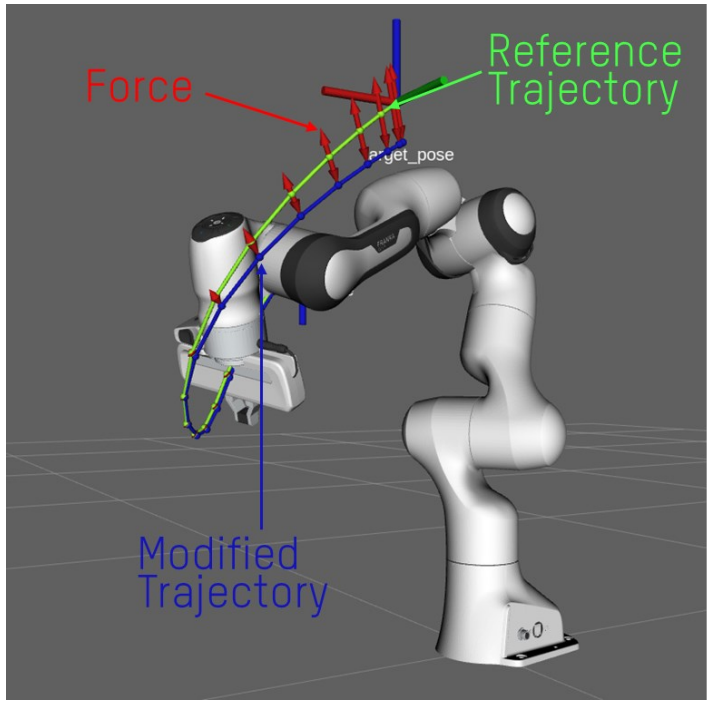
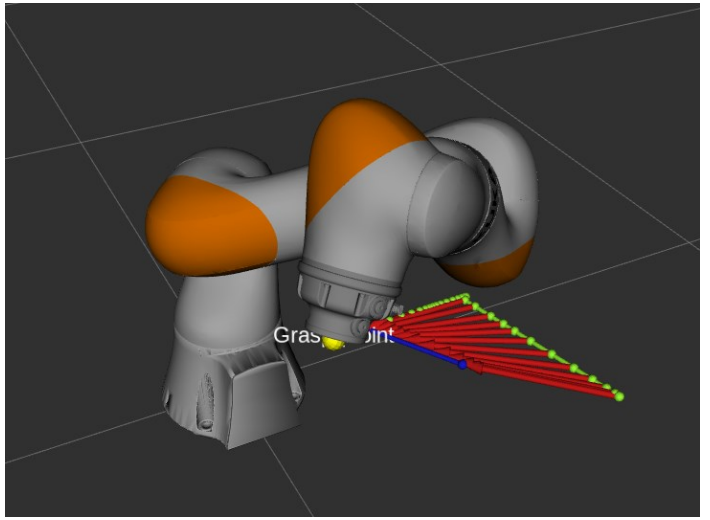
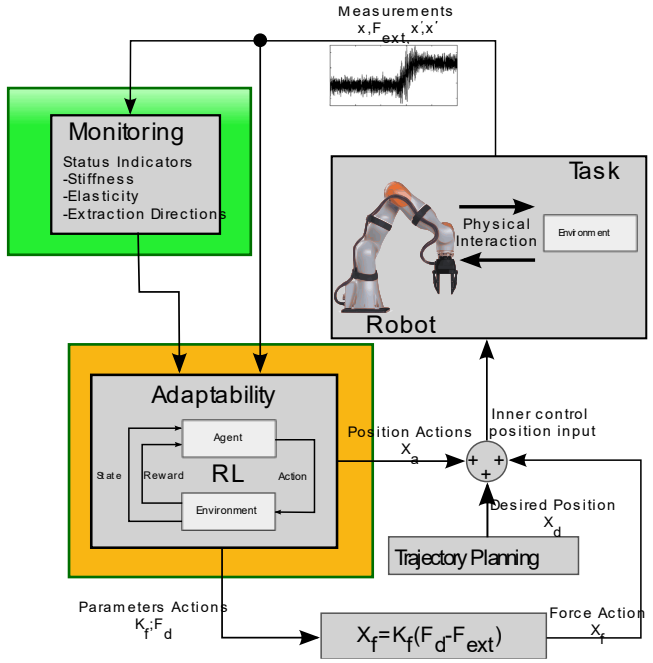
Hybrid Base Control







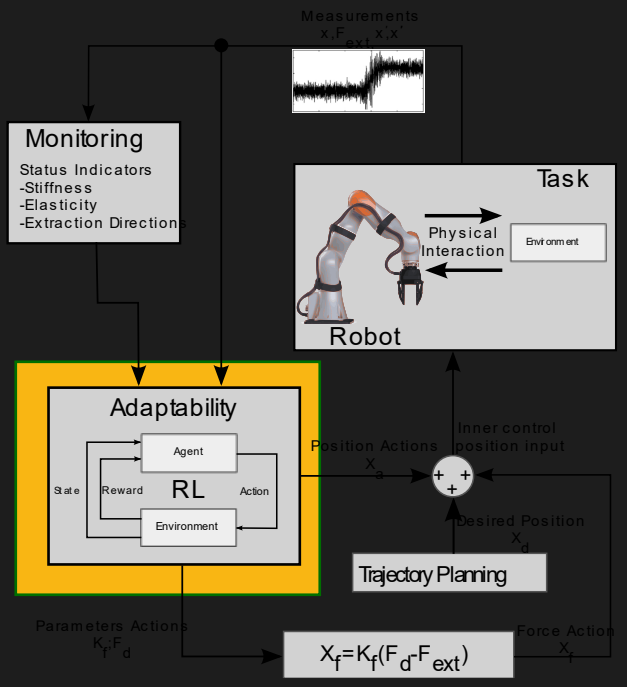
Current Work.



1 Monitoring System

2 Adaptive system

Adaptive System



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Monitoring System

Estimation

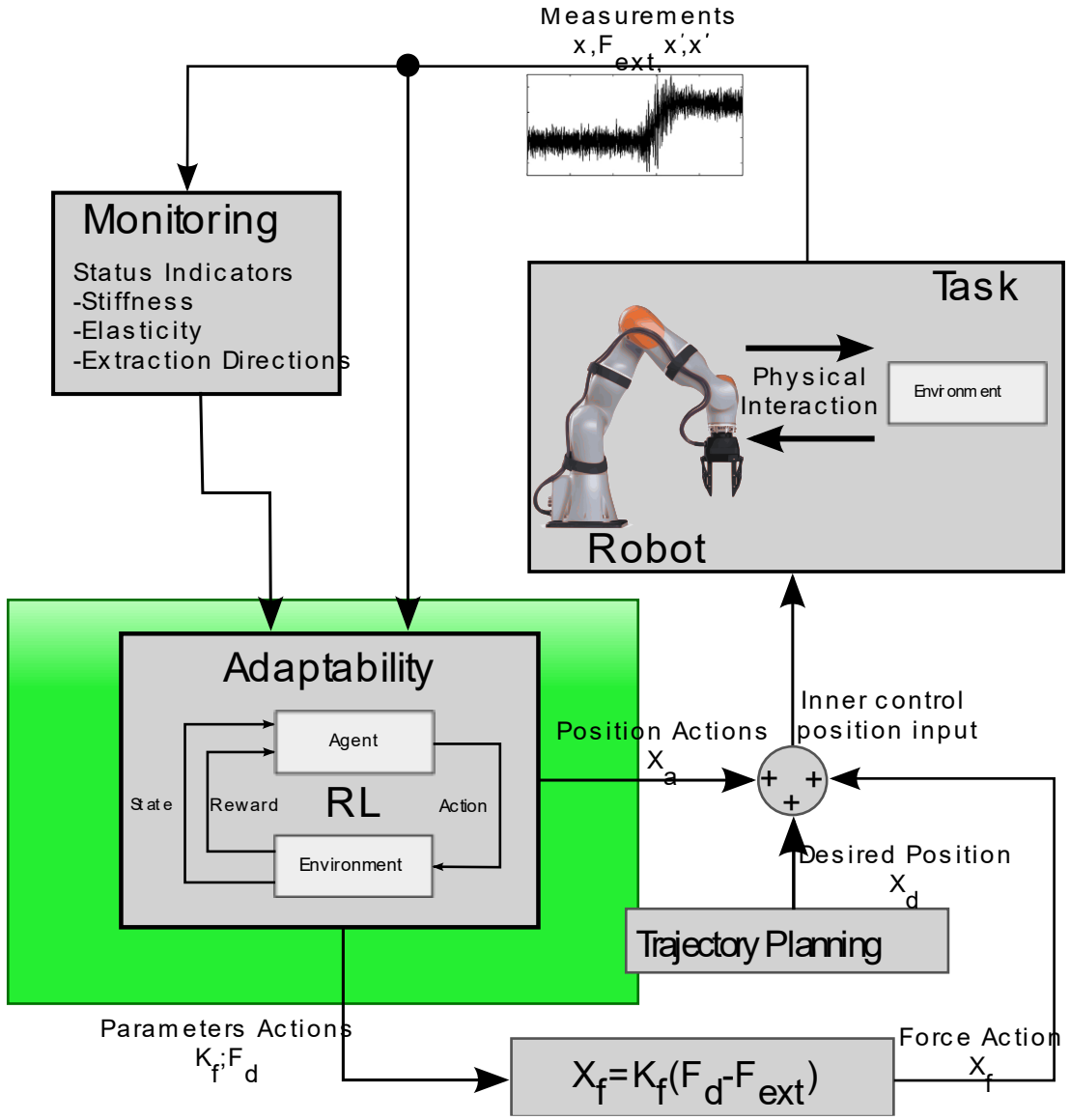
Task Indicators

Adaptive system

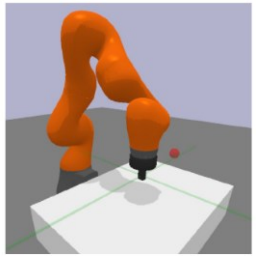
Actions

Environment

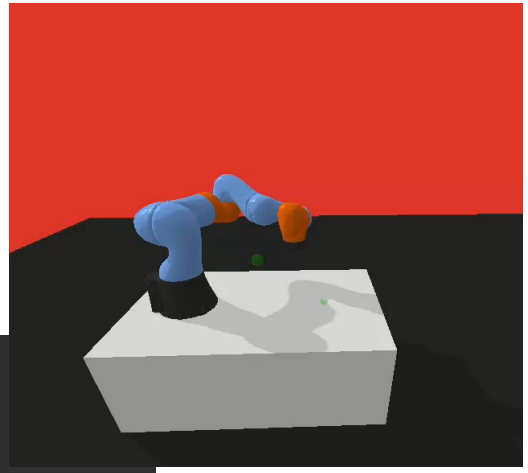
ADAPTIVE SYSTEM

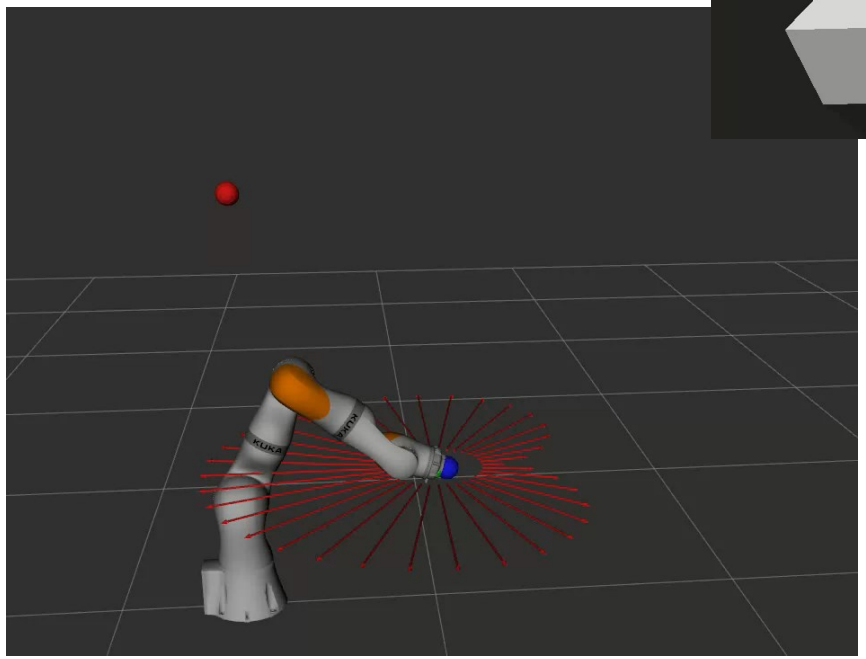


ADAPTIVE SYSTEM

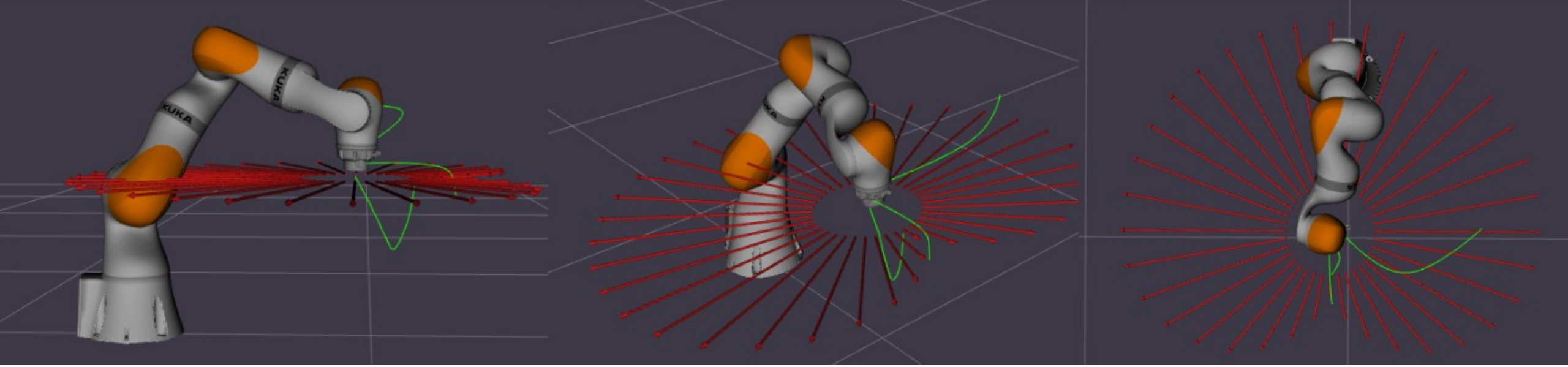


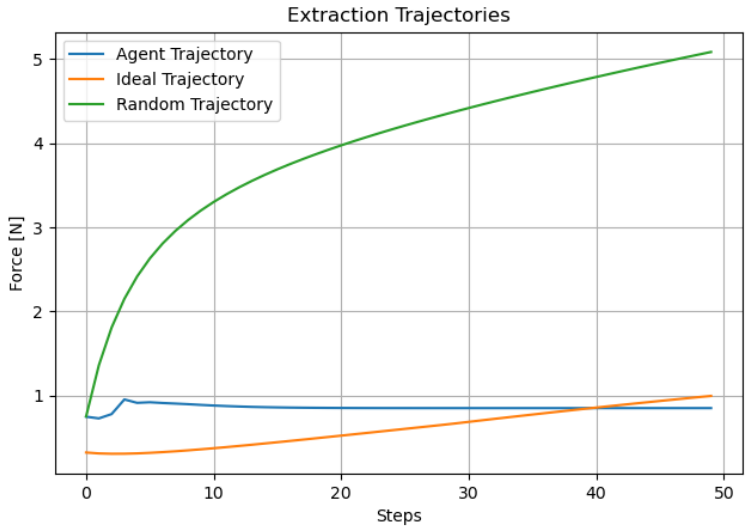
Gymnasium

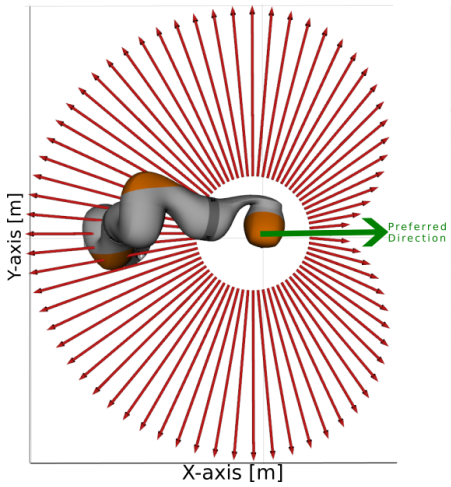


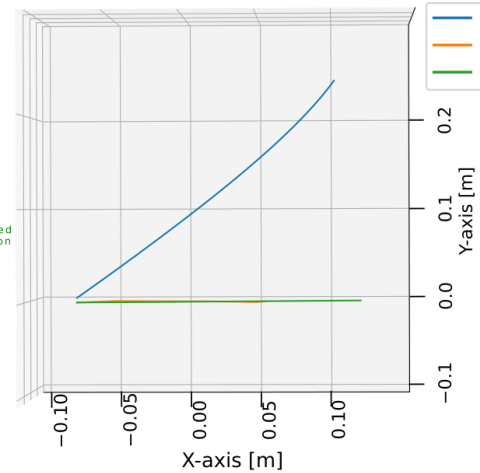


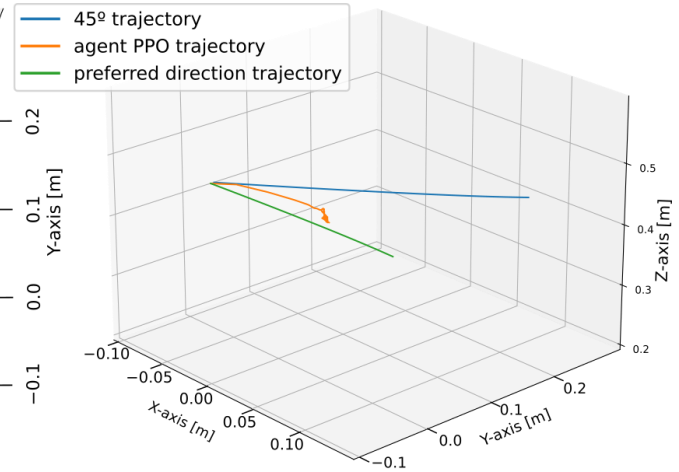
- ***Action space***
  - Direct position actions in the system
- ***State space***
  - Joints force, position
- ***Agent strategy:*** the agent strategy is related with the reward function. This reward function is the way that we specify to the algorithm what is important to learn.
- ***RL algorithm***: different kind of RL algorithm can be used for this application. The objective is to compare different algorithms with different kind of status indicators and in that way construct an autonomous system.











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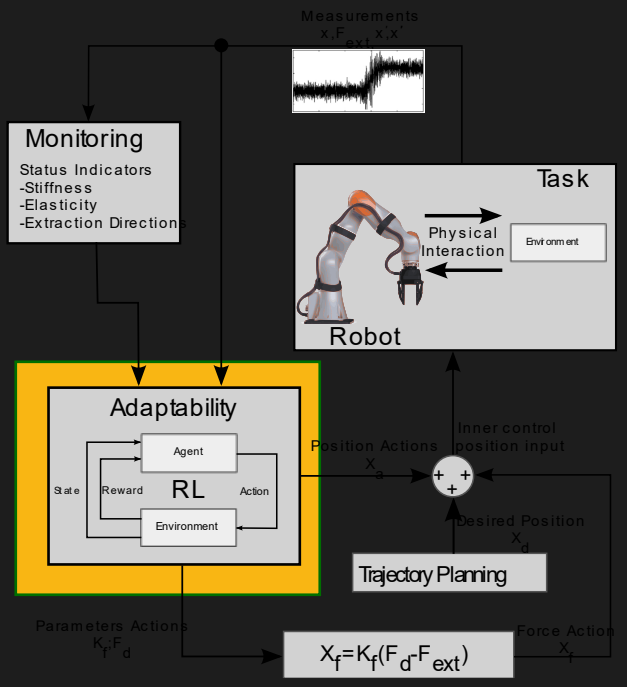
Adaptive System



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Monitoring System

Estimation

Task Indicators

Adaptive system

Actions

Environment

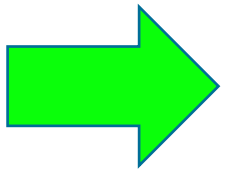
MONITORING SYSTEM

CHALLENGE

- ***Reward function variation***
  - When the material stiffness change during the task, the system is uncapable to learn about different scenarios with different forces.
  - This is related to the task objective that is dependent on the force.

SOLUTION

- ***Incorporation of advanced indicators***
  - Is proposed a normalized reward function in order to overcome the different stiffnesses during the task.
  - Is necessary to give the system the stiffness of the flexible element



New indicator:
Element stiffness

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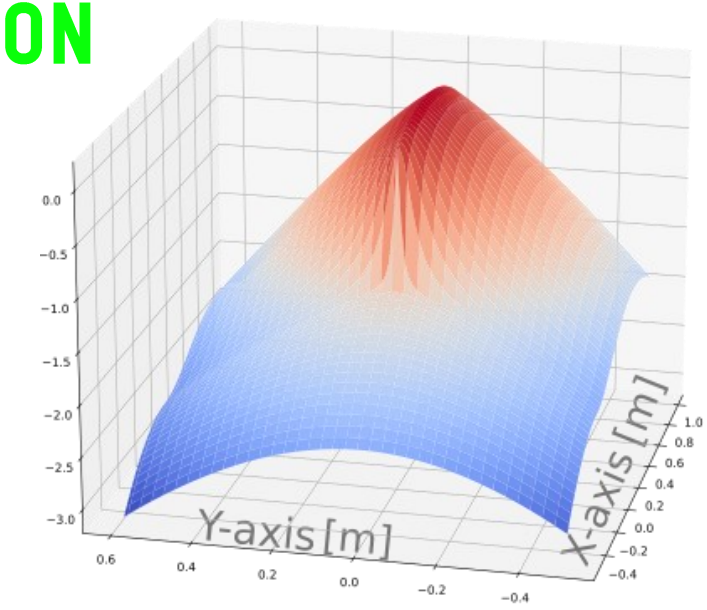
MONITORING SYSTEM

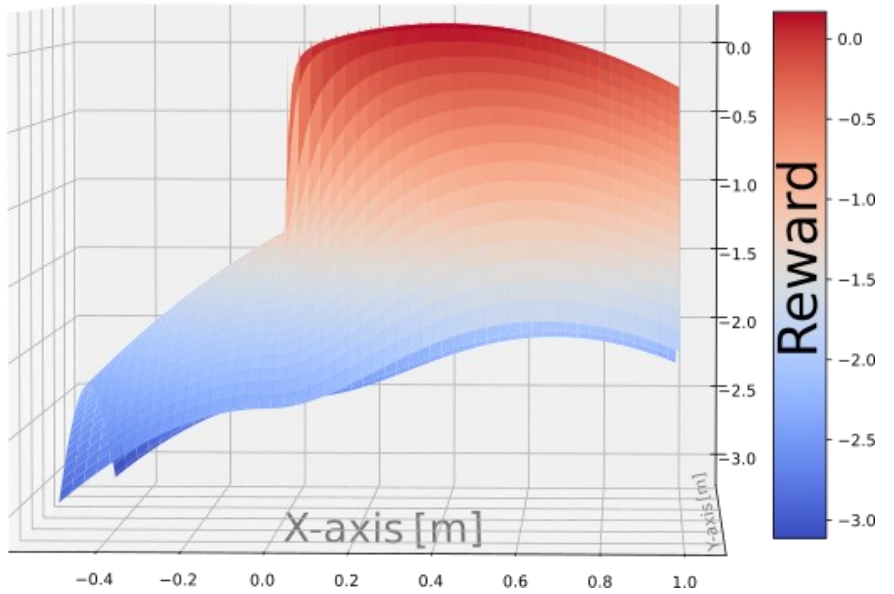
REWARD NORMALIZATION

- ***Reward function:***

R = W1 * Distance – W2 * Force^2

  - W2 -> w2(k)





SOLUTION

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New indicator:
Element stiffness

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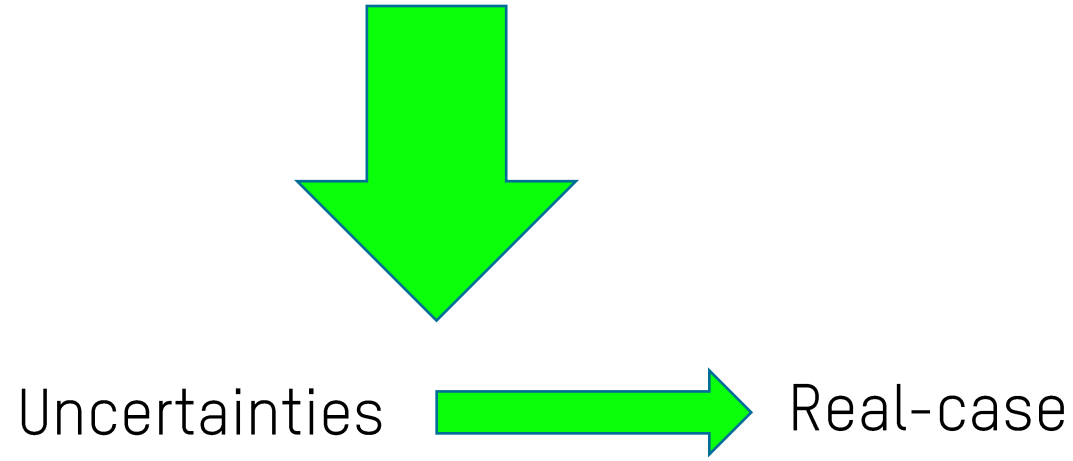
1 Monitoring System

Estimate current state



- Increase the application performance
- Maximize the use of elements
- Guarantee the robot integrity

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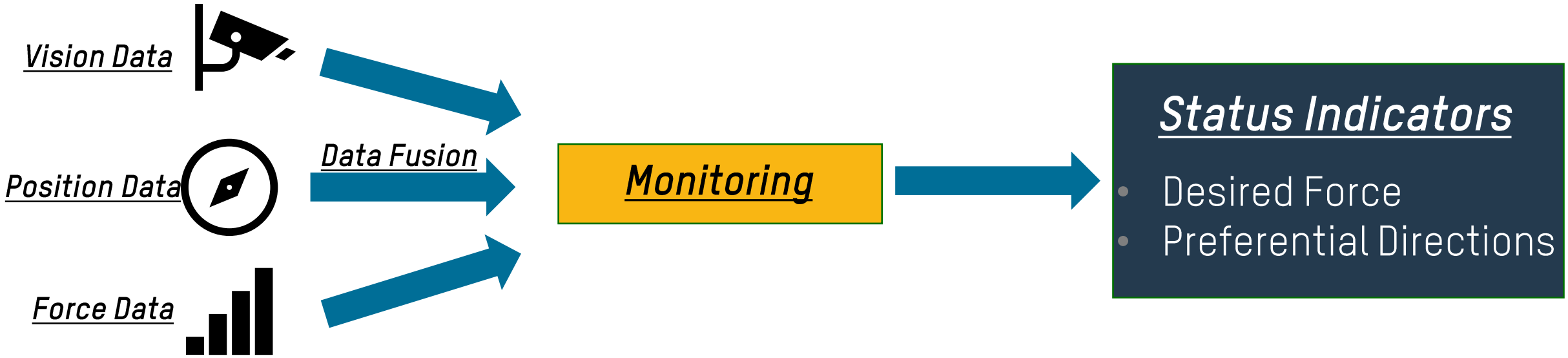
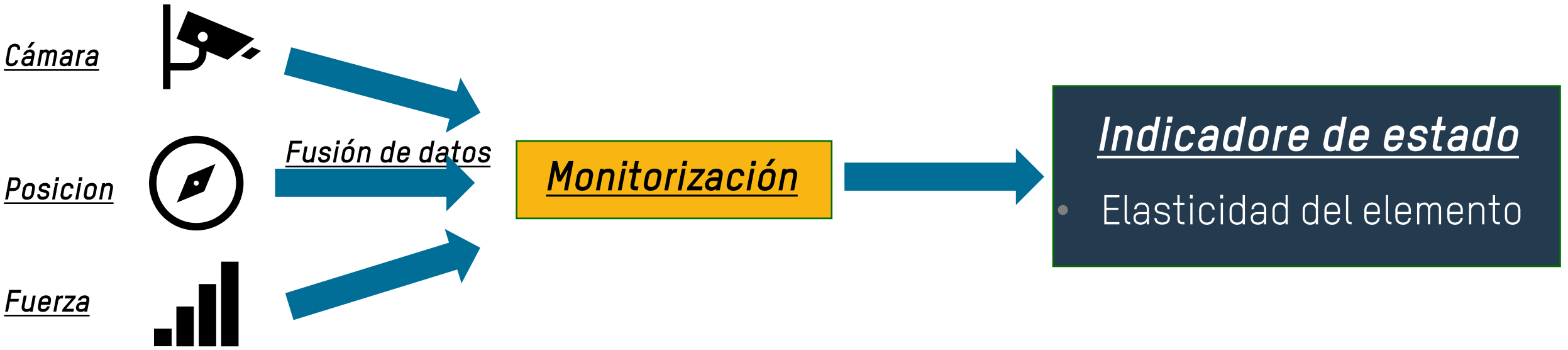
Flexible element
current state estimation





Activities Terminal Feb 6 10:01 0:00

Configuración de color

Hue Min 0

Hue Max 24

Saturation Min 35

Saturation Max 195

Value Min 170

Value Max 204

Imagen Original

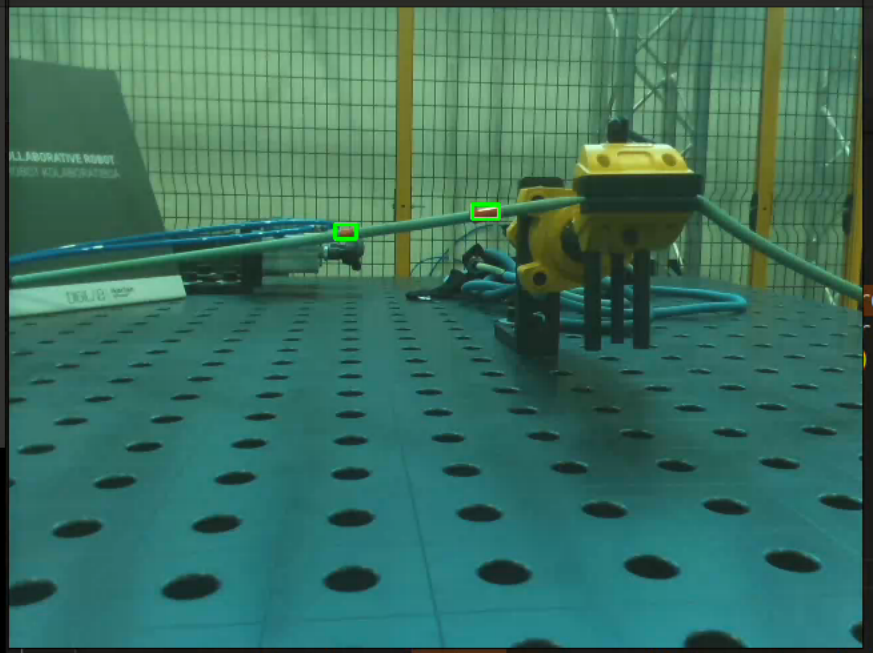
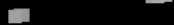


Imagen dilatada



File Edit Selection V

EXPLORER

MAITANE_PR

.vscode

build

install

log

src

custom_

include

msg

Datos

src

CMake

packag

topicos_

resour

test

topicos

__init

charu

```
    marca = pd.DataFrame(centros, columns=['id','centroy', 'centrox','distancia'])
    marca.to_excel("Marca.xlsx", index=True)
    break
```

humble@21310-0287: ~/maitane_prueba/src/topicos_posicion/topicos_posicion

humble@21310-0287: ~/maitane_prueba/src/topicos_posicion/topicos_posicion

humble@21310-0287: ~/maitane_prueba

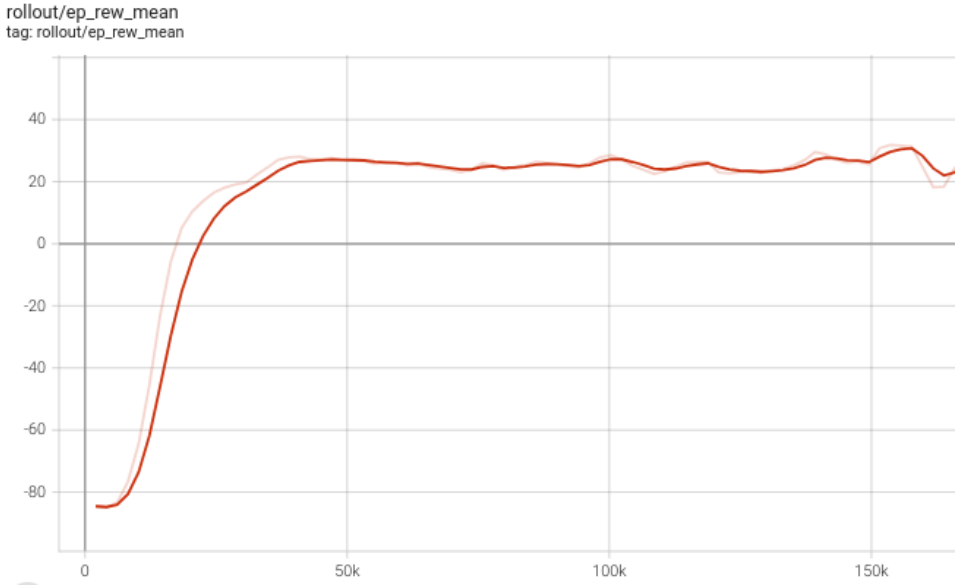
```
humble@21310-0287:~/maitane_prueba/src/topicos_posicion/topicos_posicion$ python3 main_todo.py
```

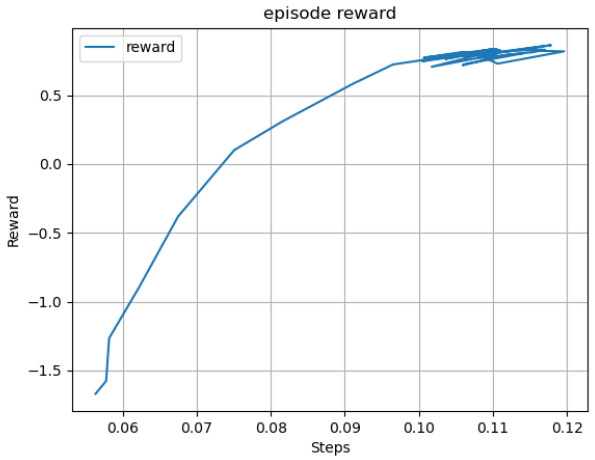
que se limpien los recursos

Ln 479, Col 14 Spaces: 4 UTF-8 CRLF Python 3.10.12 64-bit

MONITORING SYSTEM

TESTING PROPOSAL





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Conclusions

- ***Base controller architecture***
- ***Monitoring sytem***
  - Stiffness Indicator
- ***Adaptive system***
  - RL algorithm study
  - Training methodology
  - Benchmark of strategies and indicators

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This project is supported by the European Union's Horizon 2020 research and innovation program under the Marie Sklodowska-Curie grant agreement No 955681

ESKERRIK ASKO!

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¡Thanks!

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