Coordinated control of a mobile manipulator for the prehension of deformable objects

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Introduction

➢ **What is a mobile manipulator ?**

| Manipulator | Mobile | Mobile manipulator |

➢ **Interest:**

- No limit in workspace
- High redundancy degree
- System association

| Similar tasks can be realized everywhere | Several tasks can be realized simultaneously | One task can be realized by several mobile manipulators |

➢ **Exemple of application:**

| Vegetable picking | Weeding | Deformable objects transport |

➢ **Thesis objectives:**

- Coordinated control between manipulator and platform for grasping deformable object.
- Optimize manipulator positionment and workspace around the object interest using redundancy.

➢ **Scientific questions:**

- **How to coordinate motion between manipulator and platform to ensure precision of the task and stability of the system, with sliding and irregularity of the field ?**

- **How to adapt motion of the manipulator and counterbalance dynamic induced by object deformation ?**

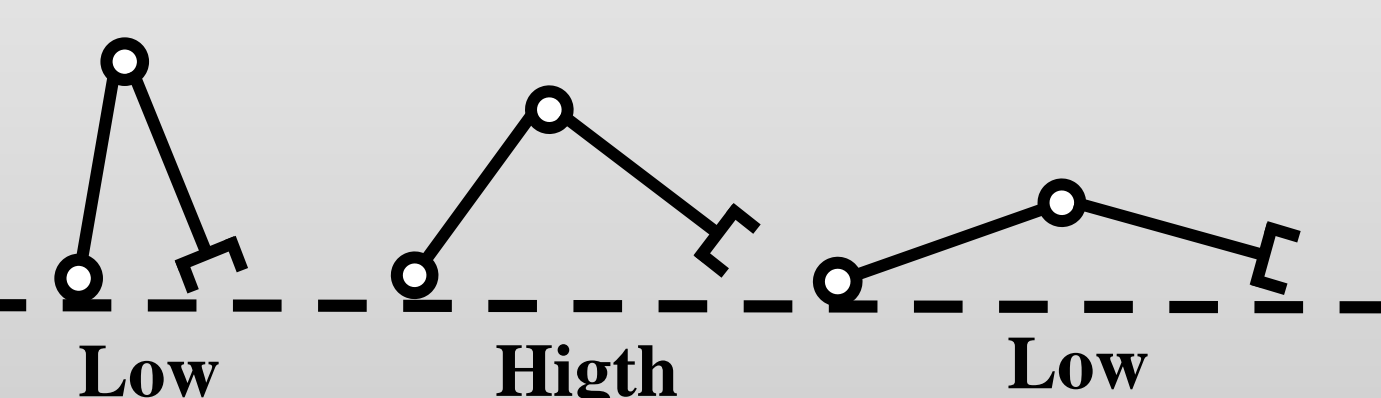- **How to use high redundancy degree to perform multi-criteria optimization ?**

Methods

➢ **Choice of model to control mobile manipulator:**

Mobile manipulator model
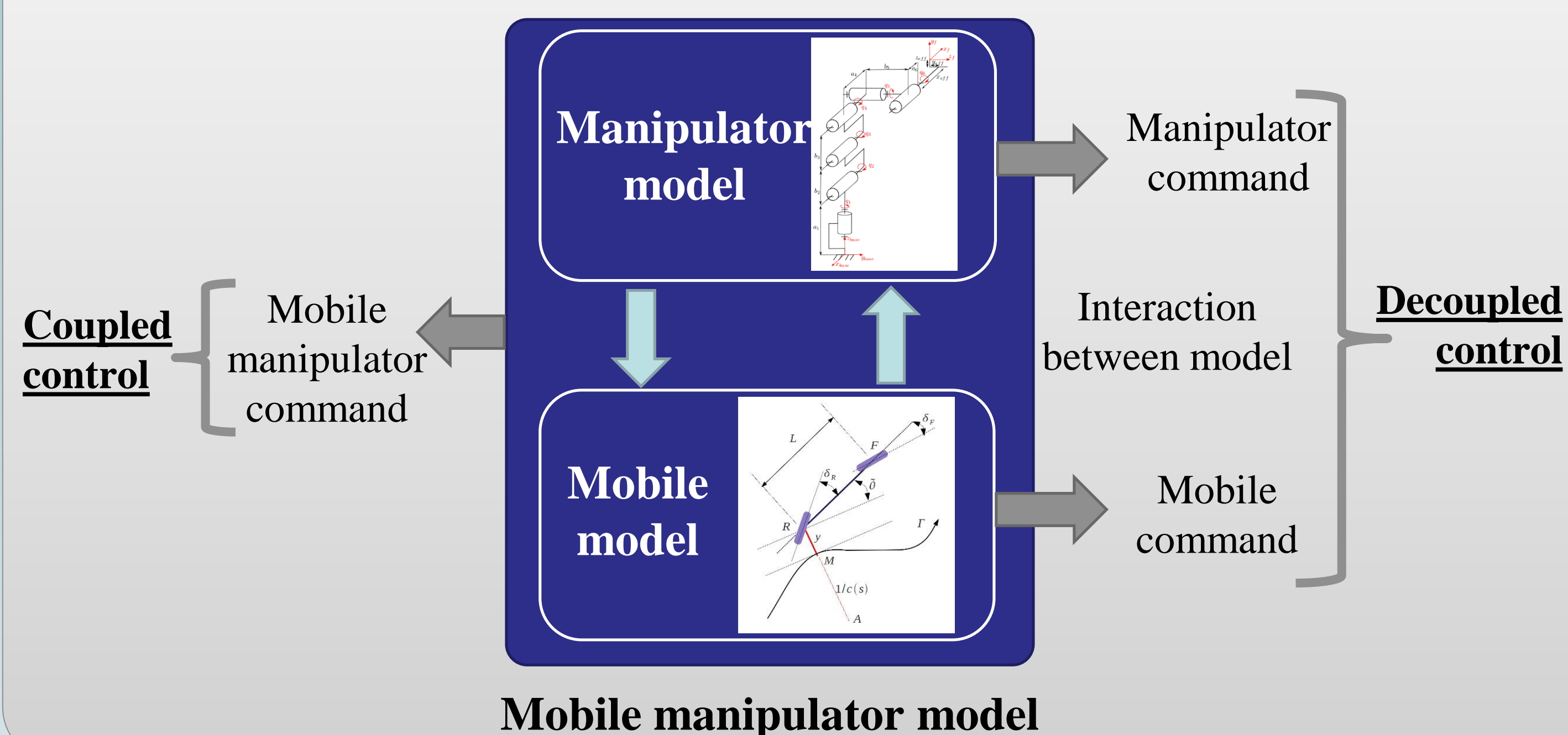
➢ **Choice of optimization criterion to control mobile manipulator :**

- Stability
- Manipulability
- Speed/Torque distribution
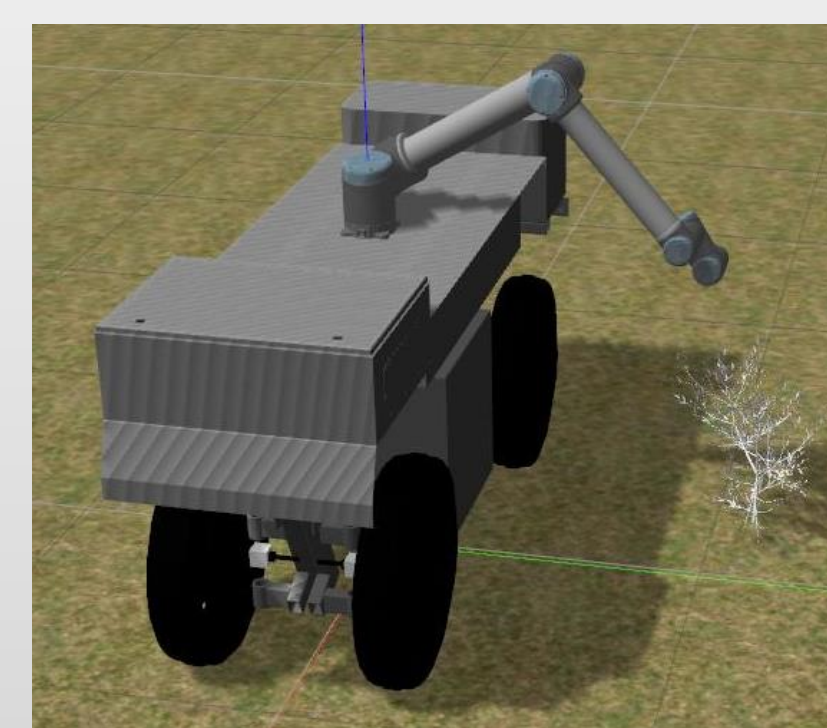- Limit joint position
- …

Ex : Manipulability[1]

| Low | Higth | Low |

[1] Tsuneo Yoshikawa. Manipulability of Robotic Mechanisms. The International Journal of Robotics Research, 4(2) :3–9, June 1985.

➢ **Control Scheme**

Objectives:
- Object Stabilisation / Orientation
- Follow trajectory
- …

Object Model

Mobile Manipulator Model

Mobile manipulator control according to the choice of optimization criterion

Perturbation

Perturbation

Produce

System Motion

Induce

Environment perturbation
- Sliding
- Fields with irregularities

Object Deformation
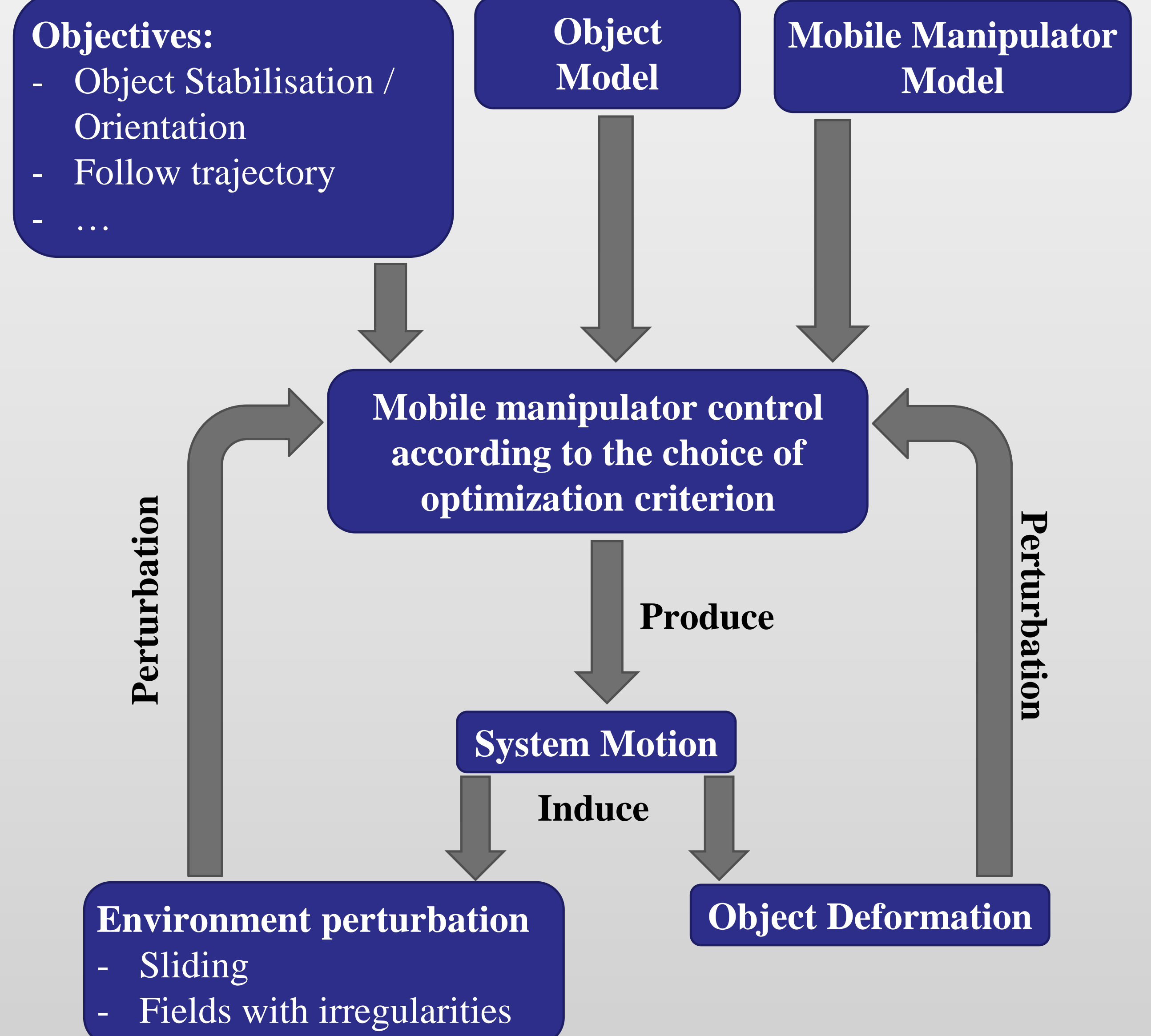
➢ **Method evaluation in simulation:**

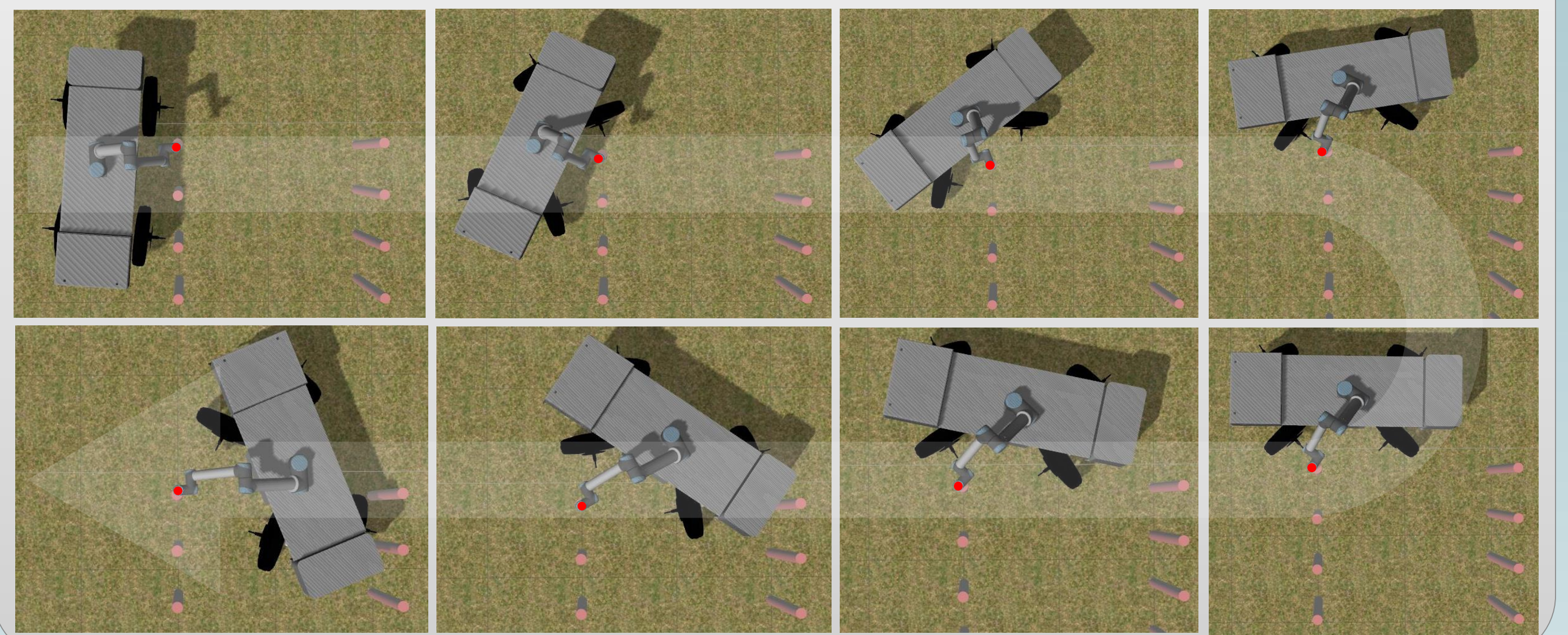- **Adap2E** (IRSTEA)
- **Campero** (IRSTEA/Institut Pascal)

ROS
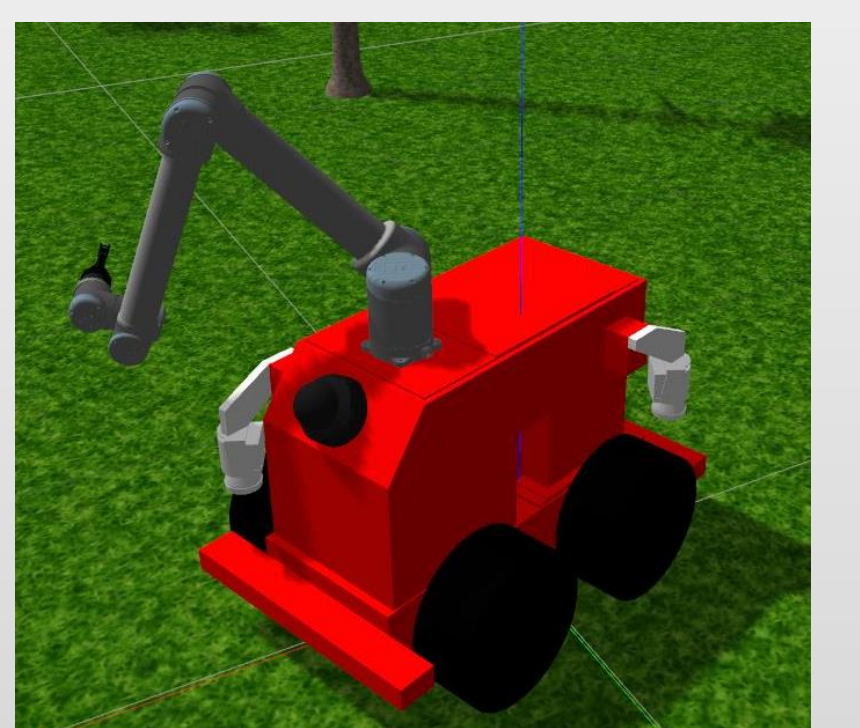
➢ **Method evaluation on real platform for future test**

Results

➢ **First application of this scheme to demonstrate coordination:**

Case : Counterbalance motion of the platform on manipulator to stabilise effector at one point in space. No perturbation was considered. Mobile has been driven manually.

Conclusions

➢ **Result:**

- First result on coordinated motion between mobile and manipulator with decoupled model.

➢ **Next step:**

- Take into account irregularity of the field(roll and pitch axes).
- Command with unified model for mobile manipulator.