Exercise 3: OCP Playground

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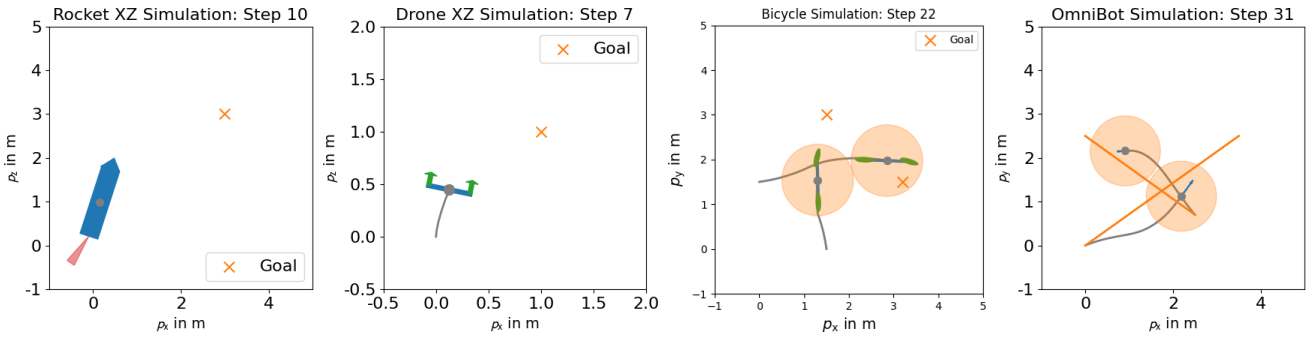
In this exercise sheet, we learn how to model, formulate, and solve optimal control problems (OCP). As a starting point, we provide several models and OCP formulations as example. These can be found in the the following repository:

`https://github.com/fmesserer/ocp-playground`



1. Familiarize yourself with the repository. Follow the installation instructions, and execute one of the examples in order to make sure everything is set up properly.

2. **Main Task:** Invent your own scenario and formulate and solve as an OCP, using `CasADi` and `IPOPT`. You can use the given models and OCPs as starting points. Here are some ideas for what you could do:

   (a) Modify a given OCP by adding more constraints to create more interesting scenarios, for example static or moving obstacles.

   (b) Modify the objective of a given OCP, e.g., let the system track a reference trajectory instead of moving towards a fixed state.

   (c) The bicycle model is kinematic (with positions as states and velocities as controls). Extend it into a dynamic form (with positions and velocities as states, and accelerations or forces as controls).

   (d) Modify a given OCP by adding more agents (you could also mix agents if they move in the same space, e.g., a drone and a rocket).

   (e) Use a given OCP as the basis to implement a model predictive control (MPC) closed-loop scheme.