

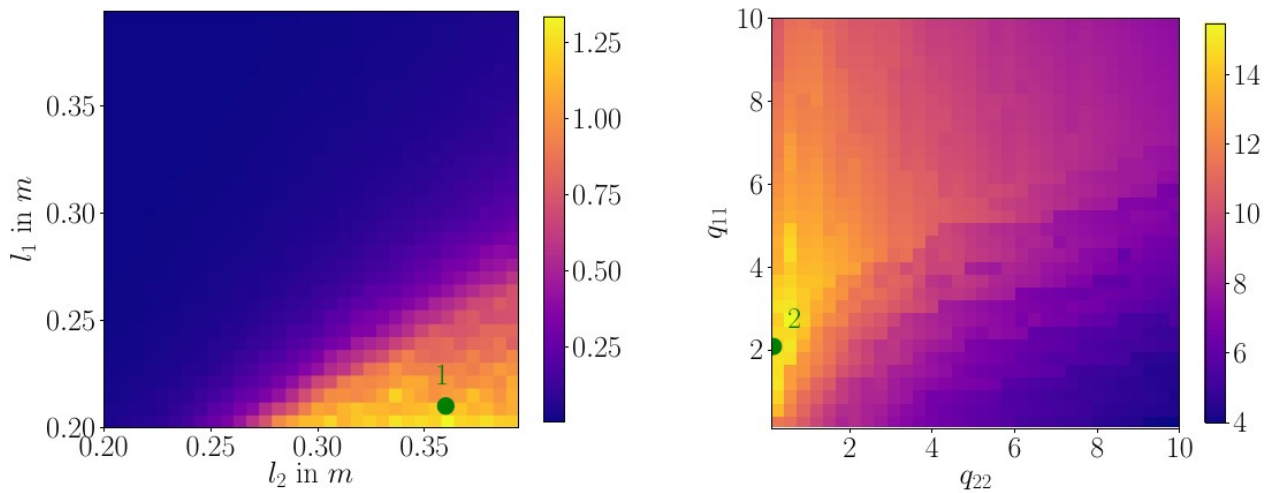
Acrobot controller and design co-optimization: time-invariant region of attraction calculation

Heatmap comparison

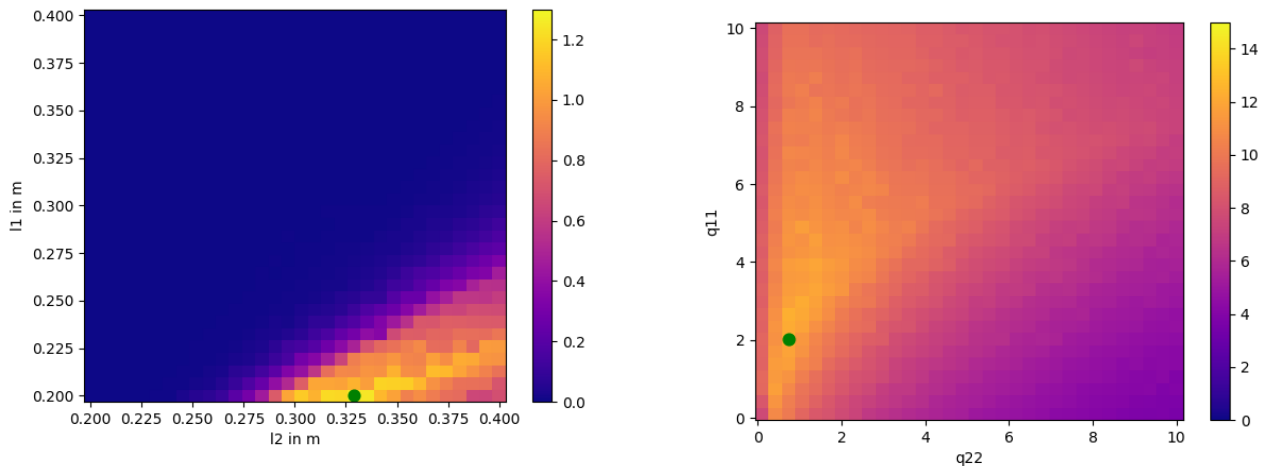
Right: Estimated ROA in the l_1 vs. l_2 dimensions for the initial design.

Left: Estimated ROA in the q_{11} vs. q_{22} dimensions for the optimal design parameters.

The green dots of the Najafi method mark the optimal solution found by the CMA-ES design first optimization strategy. The dots of the SOS method are instead representing the point where the biggest volume of the RoA has been obtained.



- Najafi method:

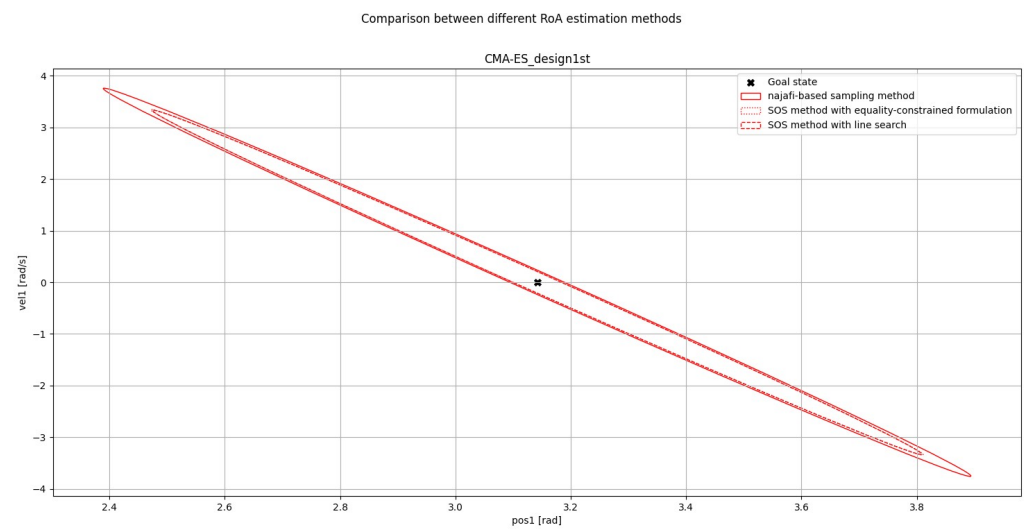
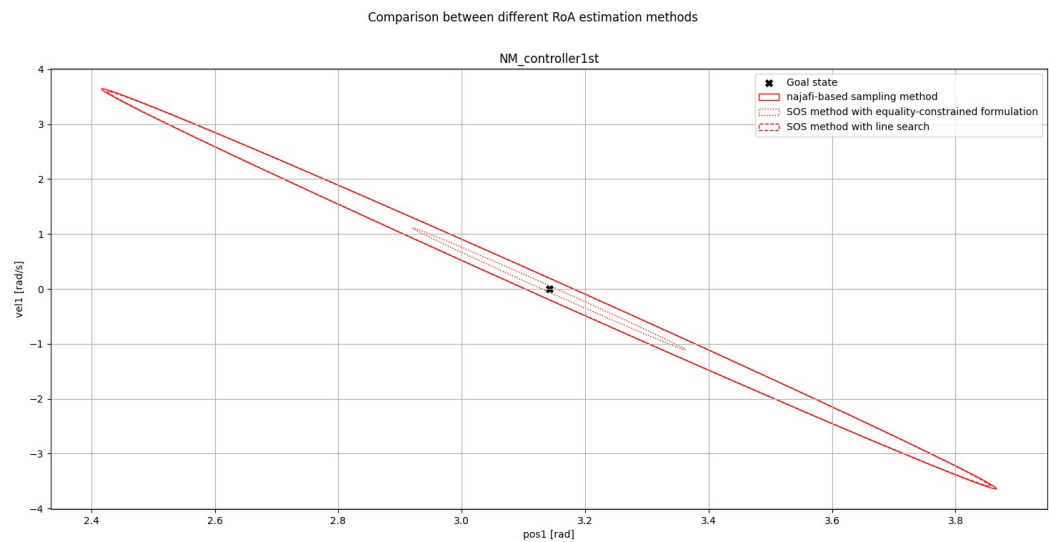
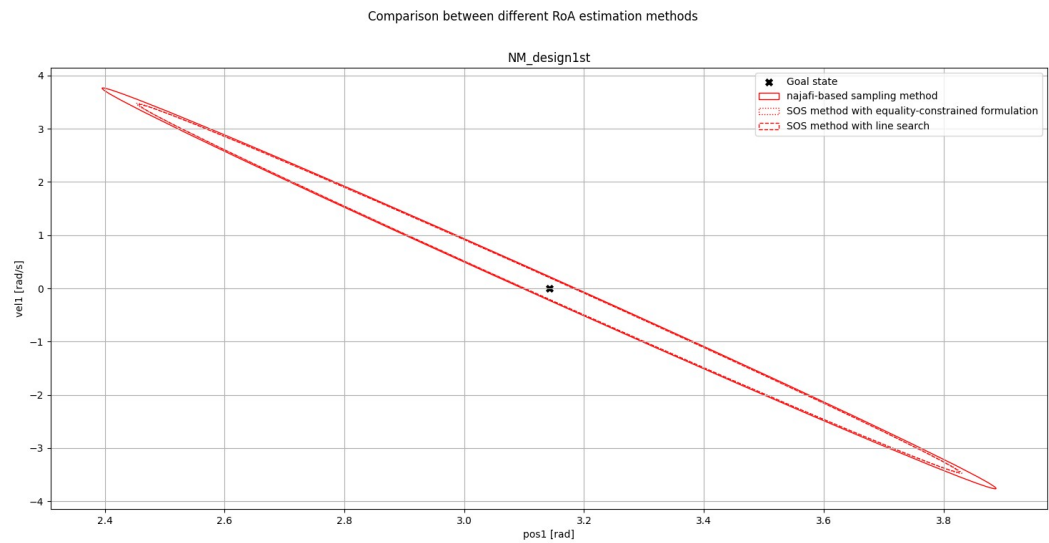


- • Sum of Squares method with simple line search:

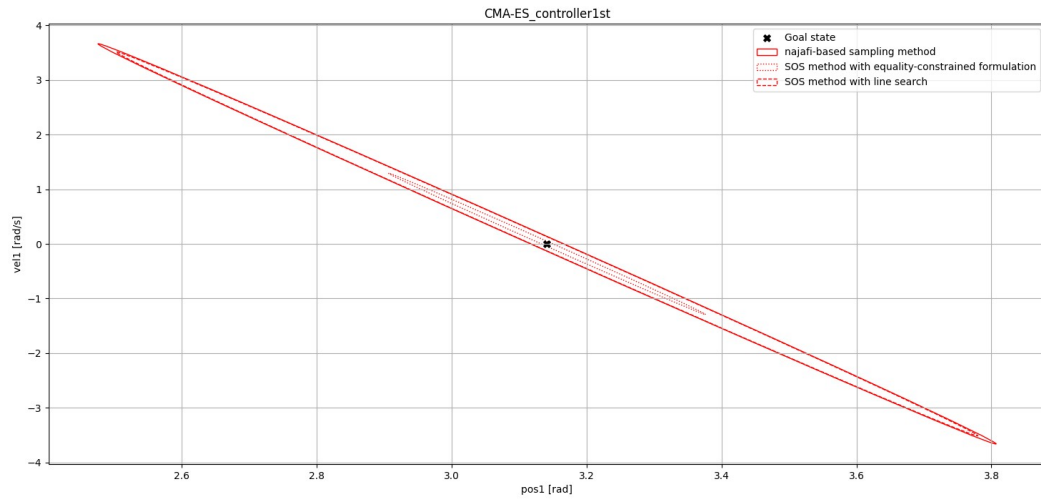
TODO: Running the design-cooptimization with the sos method and comparing the green dots consistently.

Ellipses comparison

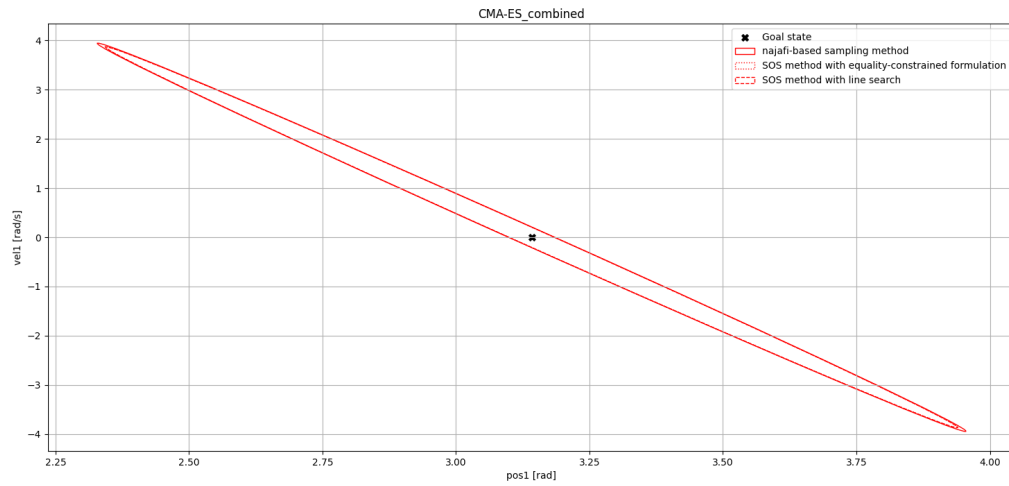
- q1_dot-q1 plane



Comparison between different RoA estimation methods

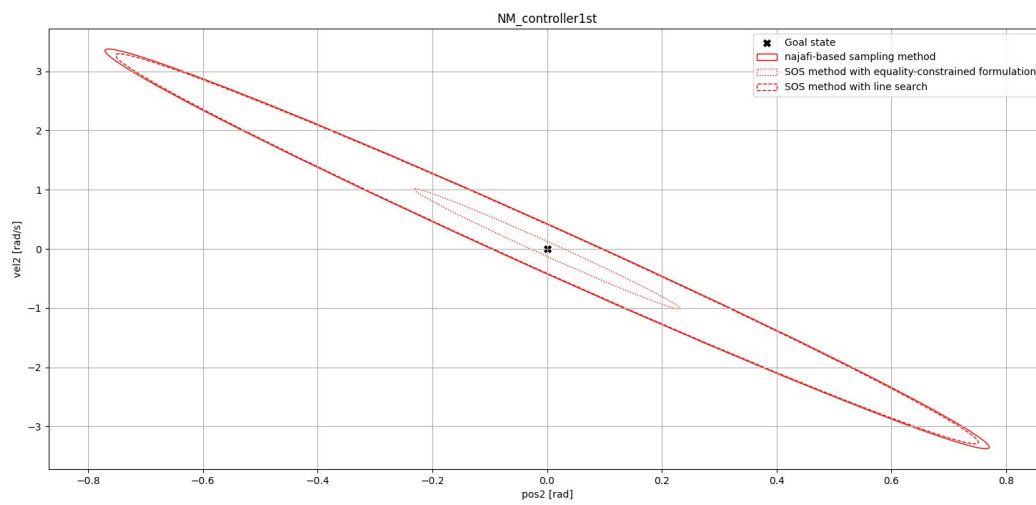


Comparison between different RoA estimation methods

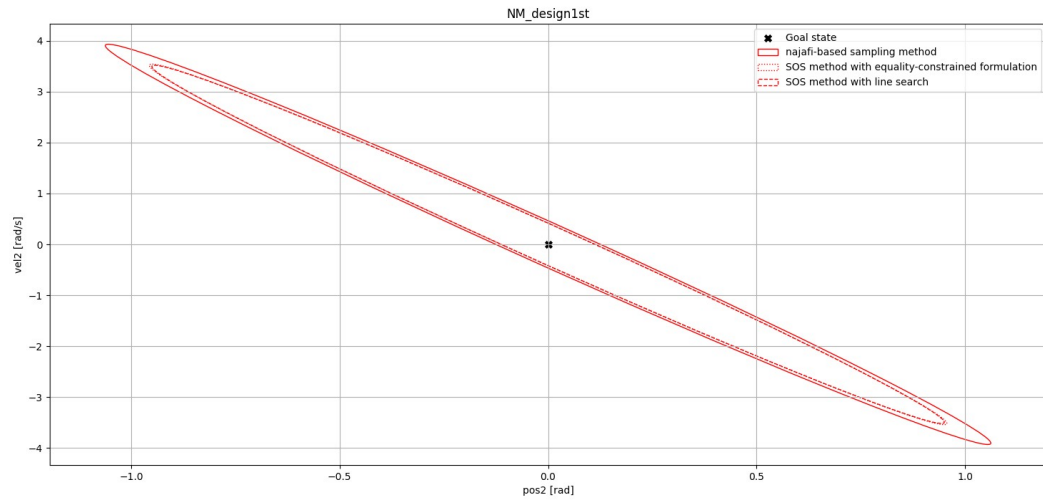


- $q2_dot$ - $q2$ plane

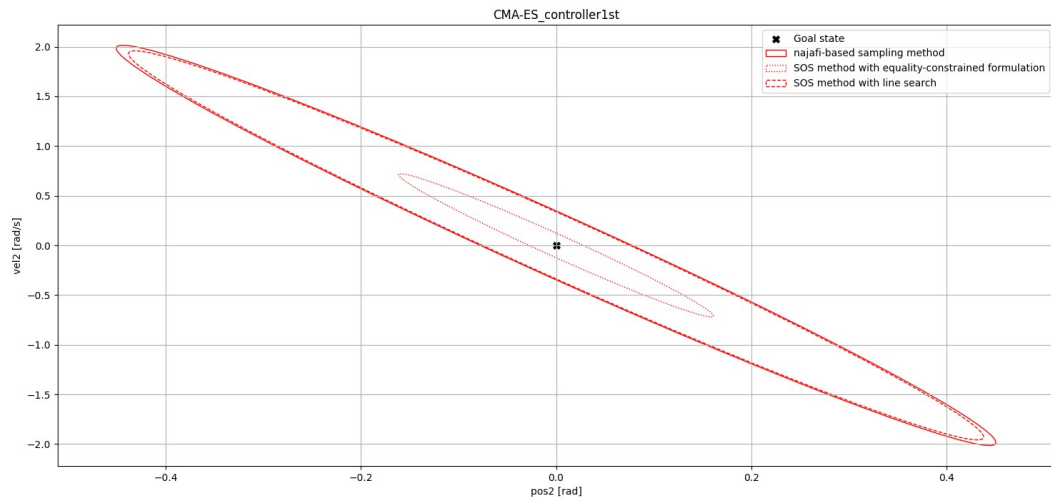
Comparison between different RoA estimation methods



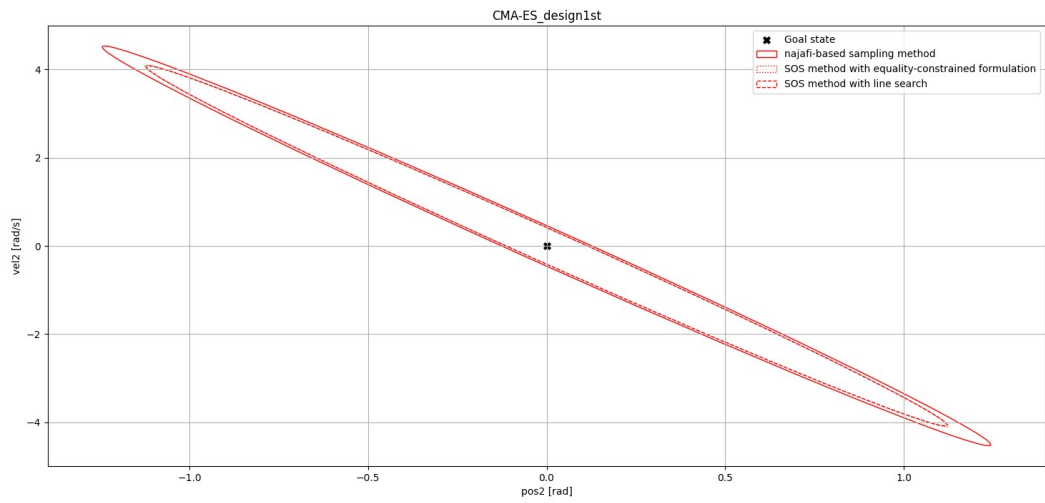
Comparison between different RoA estimation methods

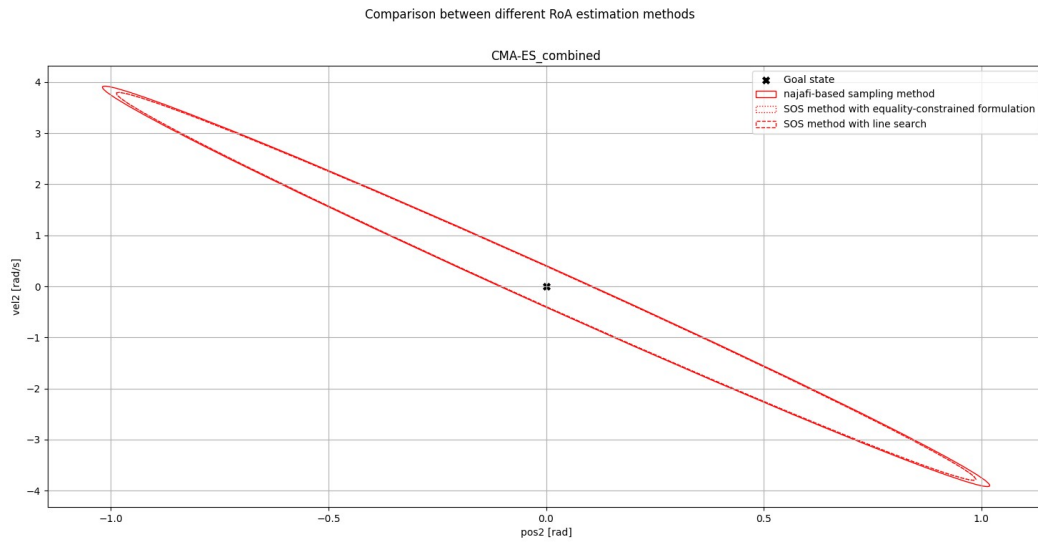


Comparison between different RoA estimation methods



Comparison between different RoA estimation methods





OBSERVATIONS:

- As expected, the Najafi method gives always the biggest RoA estimation.
- The average time needed for the estimation is approximately 55 s for the Najafi method, 4 s for the Equality-constrained formulation and 1.5 s for the SOS method with simple line search.
- The equality constraint formulation results very restrictive wrt the others as long as the design got worse.