Optimization and control of a wave energy converter

2018-2019

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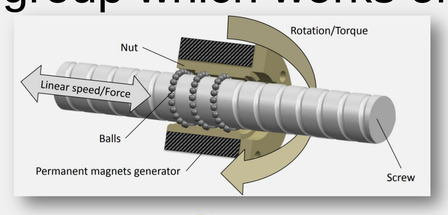
How to maximise the average output power using the parameters of the system?

• The context

IMAGINE project (European project)

- Purpose : create an affordable WEC using a new Power Take Off (PTO)
- Funded under the Horizon 2020 program
- Led by UMBRA group which works on the PTO

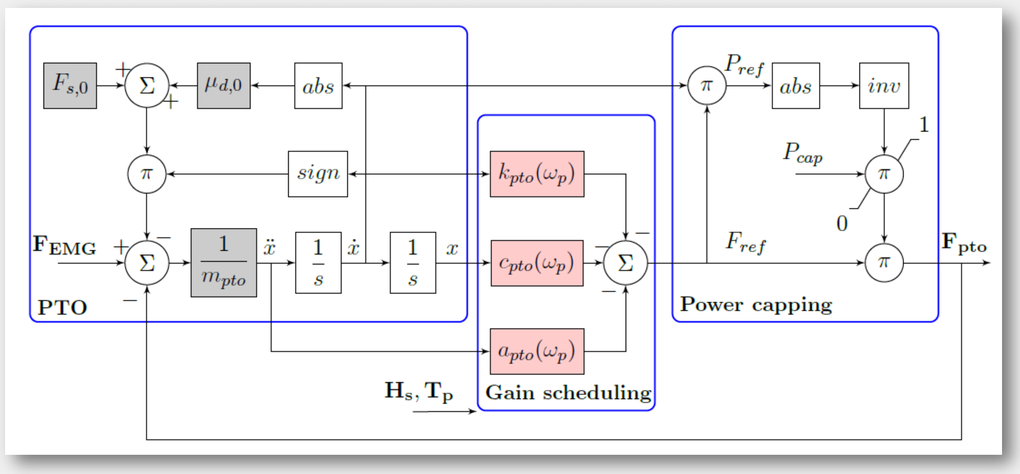


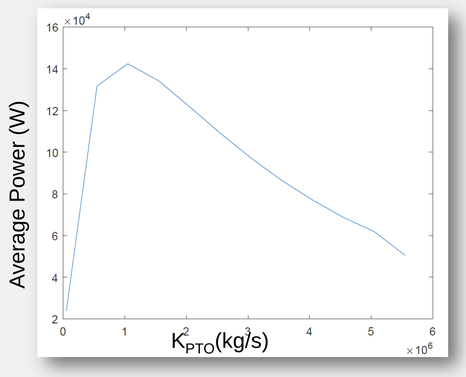
• Wave Energy Converter

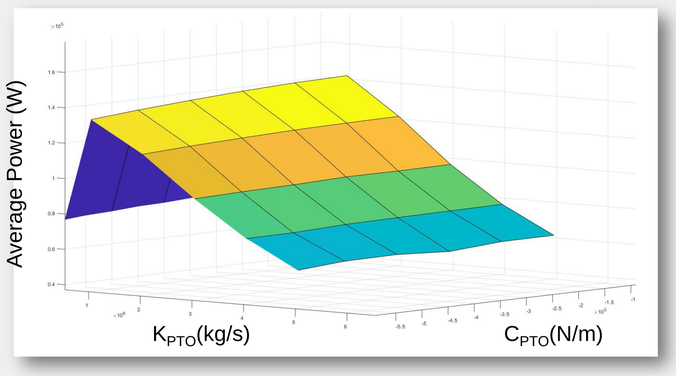
Converts **the wave energy in electrical energy**

Type of WEC : **Oscillating Wave Surge Converter (OWSC)**

• Control of the WEC







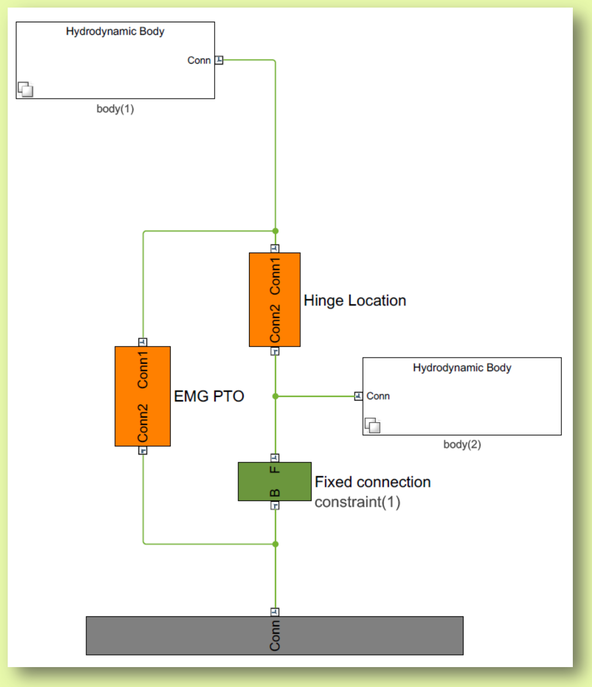
Passive control: $C_{PTO} = 0$, K_{PTO} → optimise with the function fminsearch (faster to optimise)
Reactive control: optimisation on both C_{PTO} and K_{PTO} (increase efficiency of the WEC)

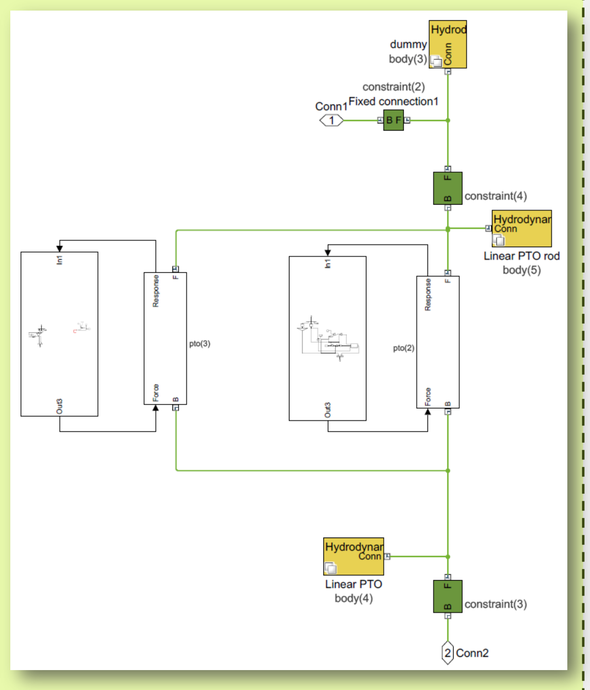
• Optimisation

Goal: reduce the number of call of the simulation
Realisation: for each optimisation the initial value for the parameters to optimise is the one found for the previous sea state. A similar method is used for the calculation of the friction forces

• Simulation of the WEC

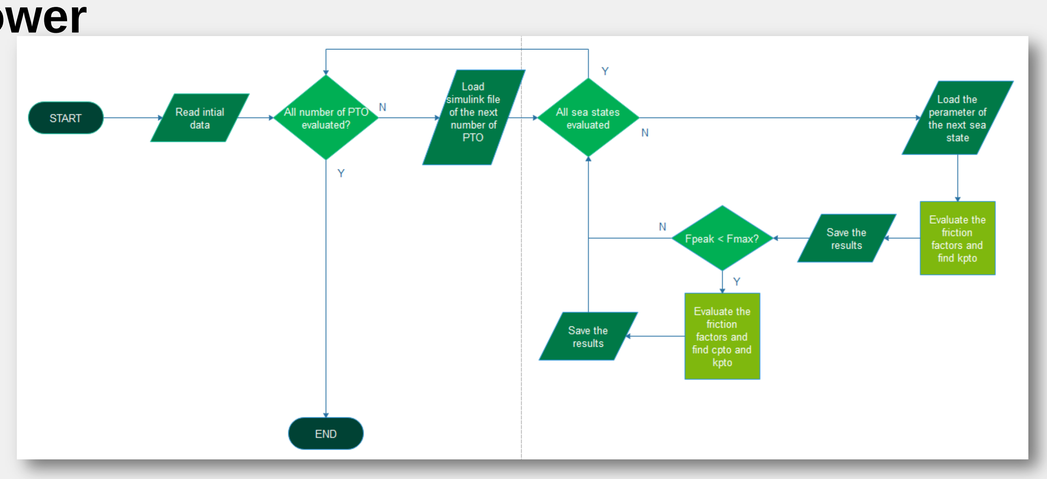
Use of the WEC Sim library (based on Simulink)





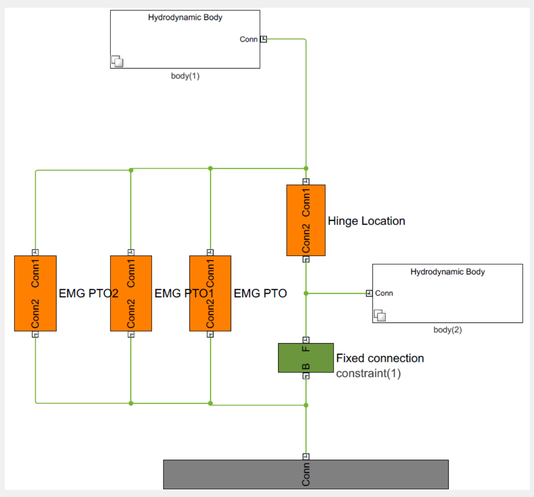
• Optimization process

Data: sea states (significant wave height, wave peak period occurrence during a year)
Goal: found the damping coefficient (K_{PTO}) and the stiffness coefficient (C_{PTO}) → maximum **average power**



Compare simulation with time step 20ms and 50ms
Results: Passive control → time step **does not make any difference.**
Reactive control → time step **makes a difference** on the average power (17%)

• Multiple PTOs



- Find how the number of PTOs impacts the efficiency of the WEC
- Optimize the number of PTOs of the system at the same time as optimizing the PTOs parameters

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