
DTU

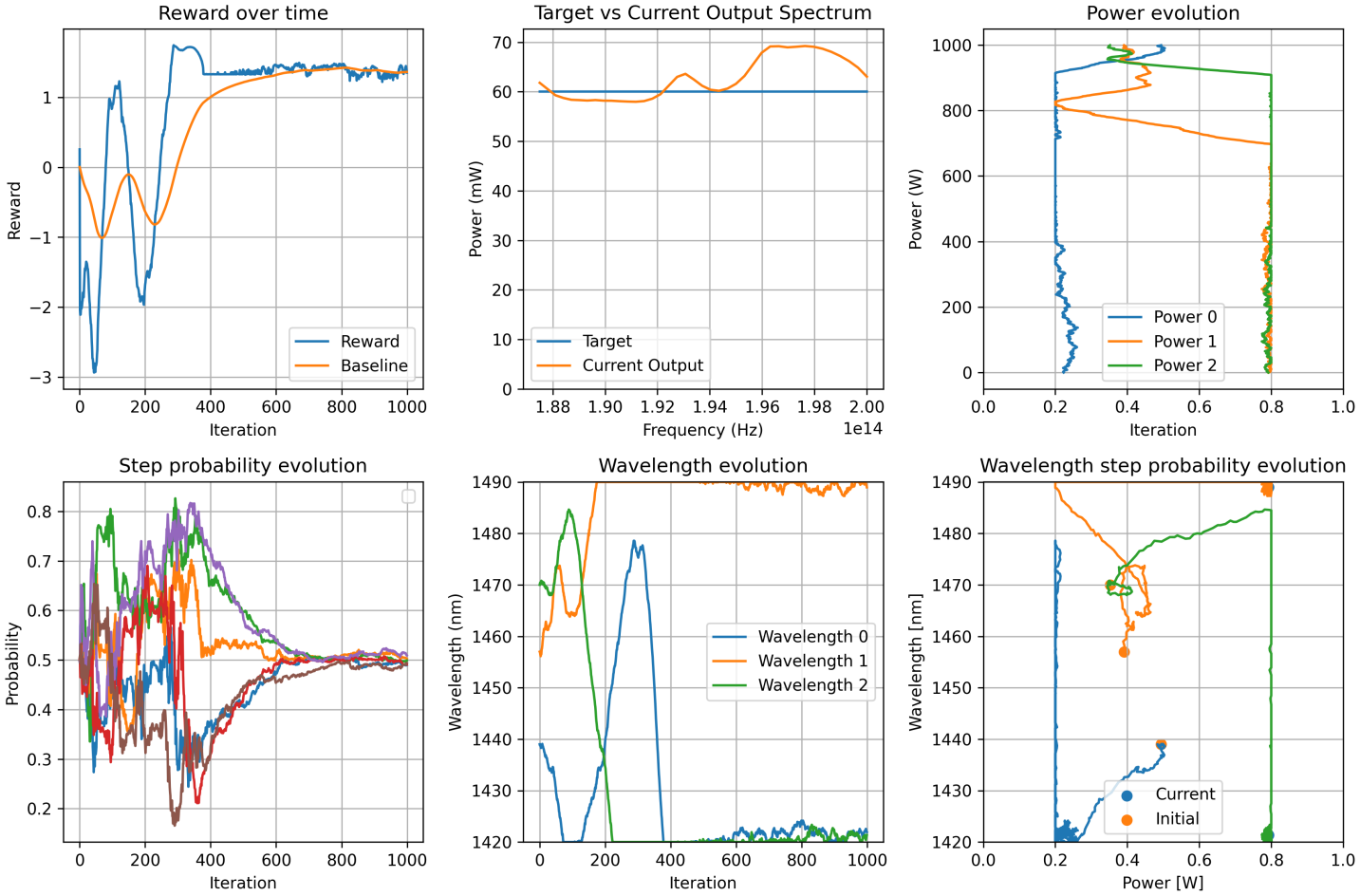
Reinforcement Learning Control of Raman Amplifiers
13.11.2025

Three pump Raman amplifier simulator

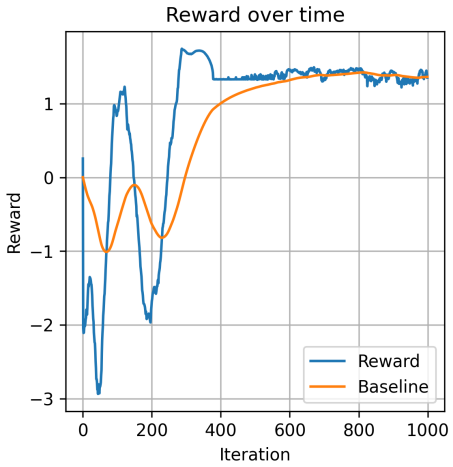
The three pump simulator works on the same principle as the single pump simulator, currently relying on linearization of the process.

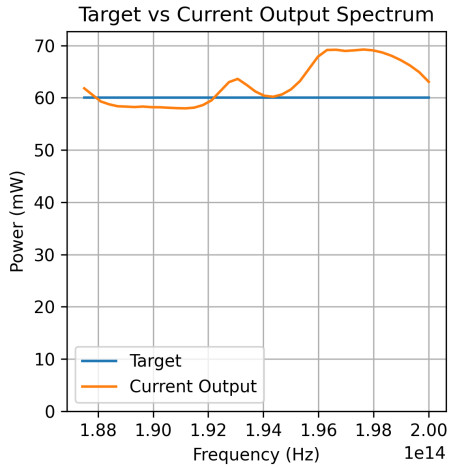
The three pumps are treated as three separate Raman amplifiers, and their outputs are summed together into a single spectrum.

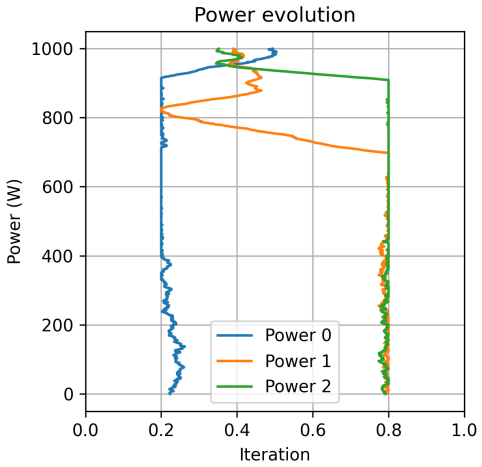
Is this level of approximation acceptable for control simulation purposes?

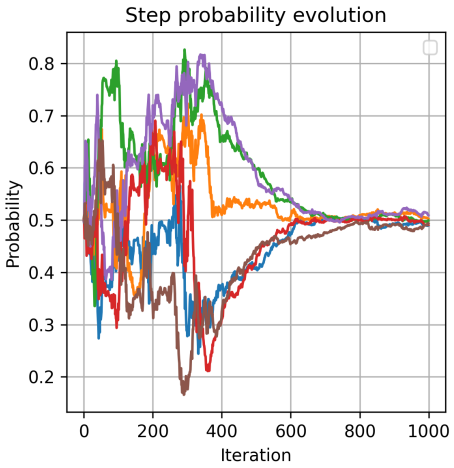


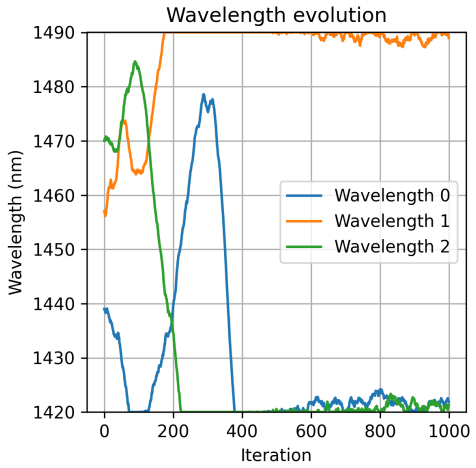
Reward Function modification

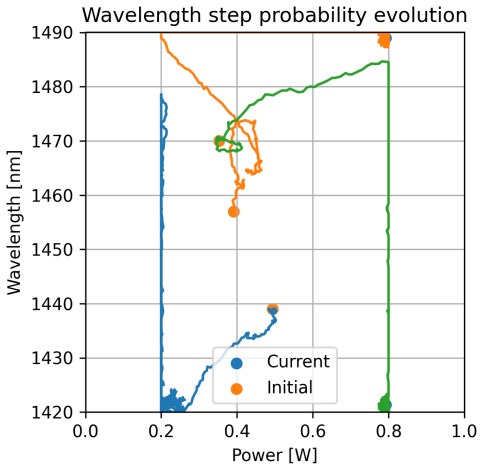












Since we have the ability to have n pumps in a Raman amplifier, it is important to take note of potentially useful modifications to the reward function.

Currently, the reward function maximizes the wavelength difference between components. The goal of this modification is to make sure that no two pumps are pumping the same wavelength, which can lead to further issues in power optimization.

Apart from this change, there are numerous alternatives which could make sense from an engineering perspective.

Results

Looking at the results achieved with the multi-pump system, with the goal of reaching a flat power profile, starting from a flat input profile, we can see that the results achieved by the control system are better than in the single-pump system.

Parameters used:

- Fiber - Standard Single Mode Fiber (Erwan's dataset), 80 km.
- Raman Amplifier - Three pumps, only backwards pumping.
- Controller - Bernoulli controller, REINFORCE algorithm.