
DTU

Reinforcement Learning Control of Raman Amplifiers
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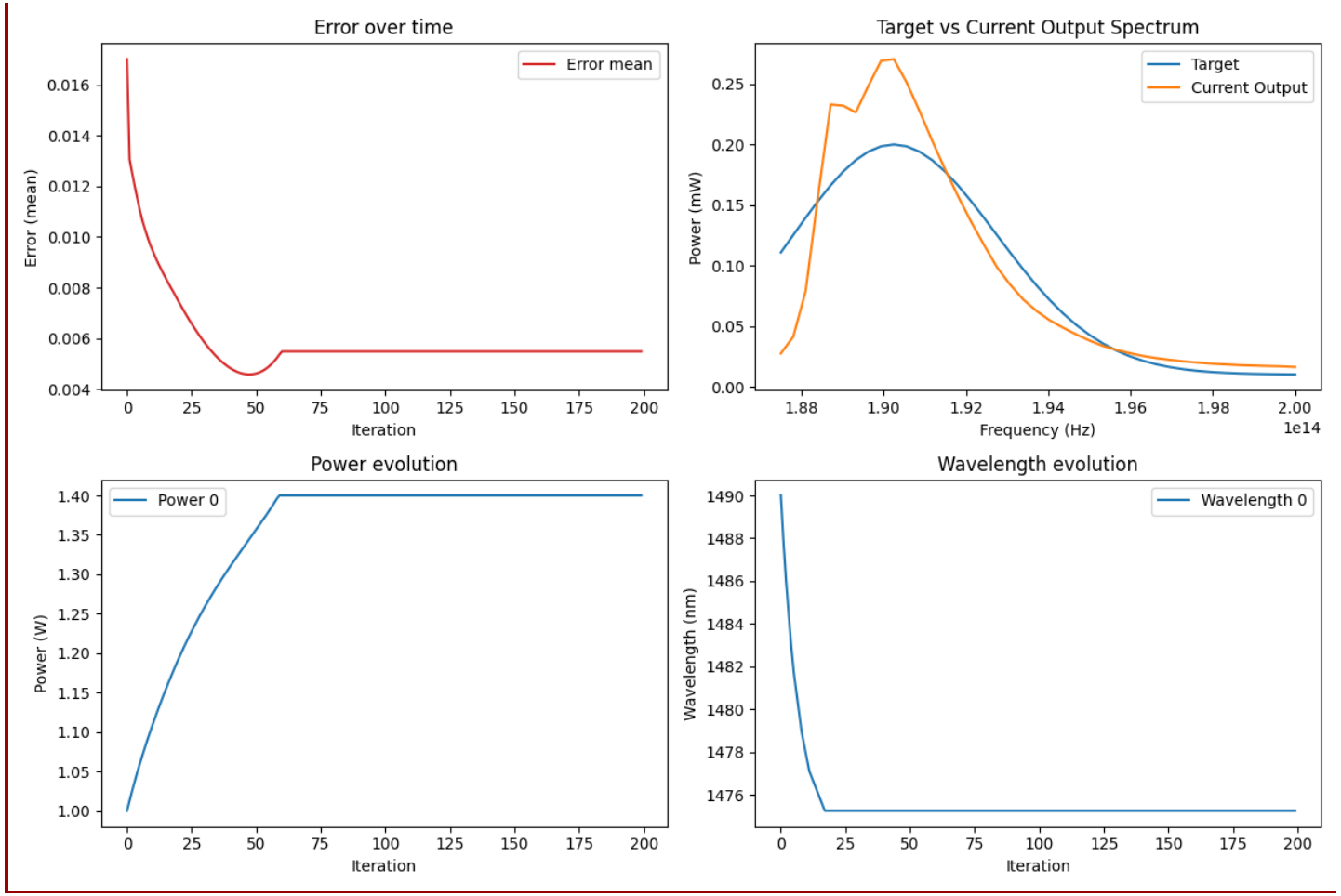
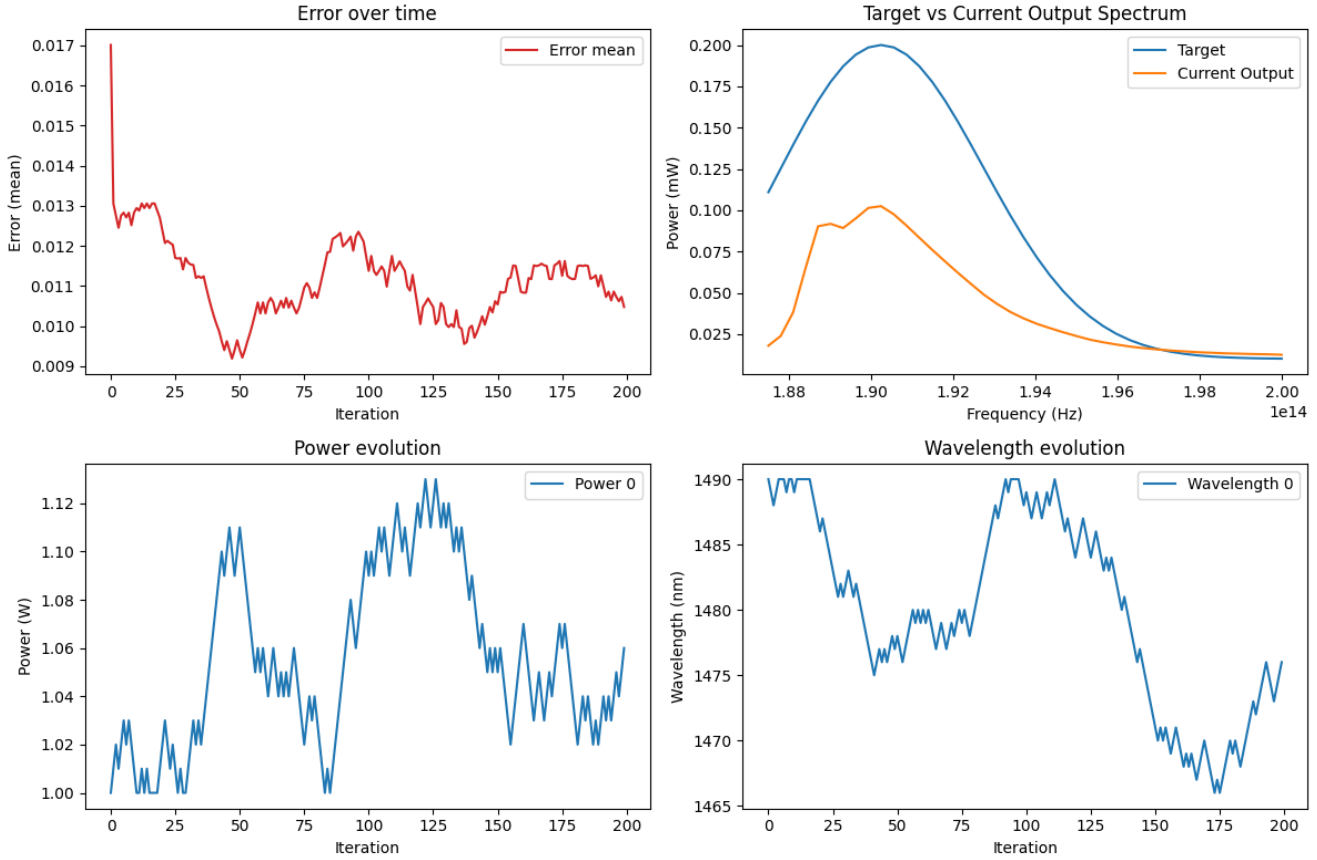
PID Controller

- The PID Controller for the Control system with a single pump Raman amplifier is implemented using two PID controllers:
- The Power PID controls the pump power by calculating the mean squared error of the output and target spectrums.
- The Wavelength PID controls the pump wavelength by finding the peak in output and target spectrums, and moving the wavelength to match the peak frequencies



Bernoulli Controller - Results

- The Bernoulli Controller functions by sampling the Bernoulli distribution and mapping the samples to increase or decrease the inputs of the Raman amplifier.
- The logits which describe the Bernoulli distribution are optimized using the REINFORCE algorithm.



Bernoulli Controller - Discussion

- The Bernoulli controller represents the simplest form of Reinforcement Learning, and it shows promising results, although lackluster in comparison to classic control.
- To achieve these results, some constraints had to be implemented:
  - The range of wavelengths had to be adjusted to keep the peak of the spectrum inside the C-band.
  - The range of powers had to be restricted above 0W, to keep it from converging to 0W.
- When running the experiments, I noticed the pump power converging to 0W, as that is the simplest way to quickly minimize the error, which is the expected behavior of the REINFORCE algorithm.
- The constrained inputs are the simplest way of mitigating this issue, but the proper solution would be to optimize the reward function, as our solution can only be as good as the reward function.
- Candidates for a better reward function in this specific case would include the frequency difference of peaks in output and target spectrums.