DTU

RL Control System for Raman Amplifier
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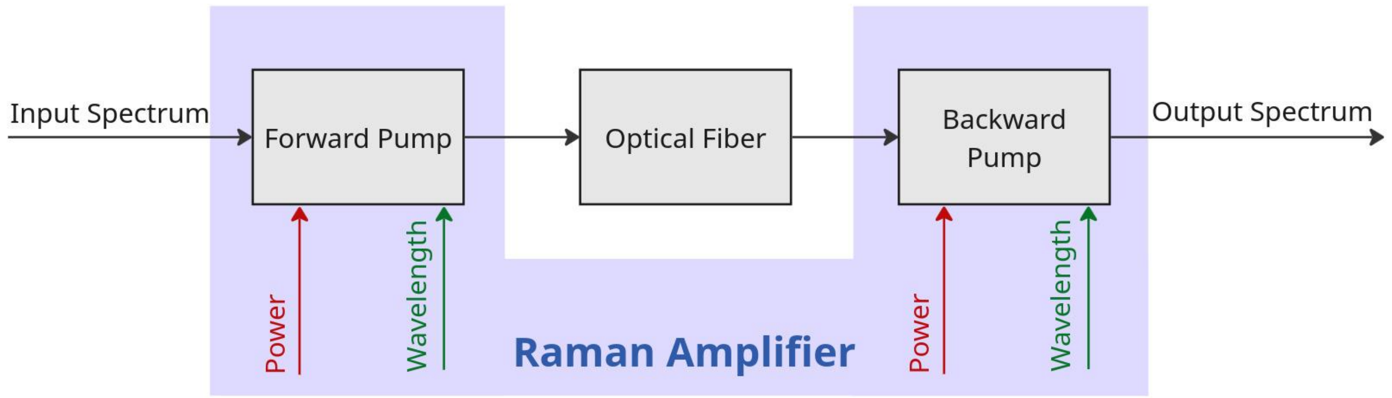
Raman Amplifier System

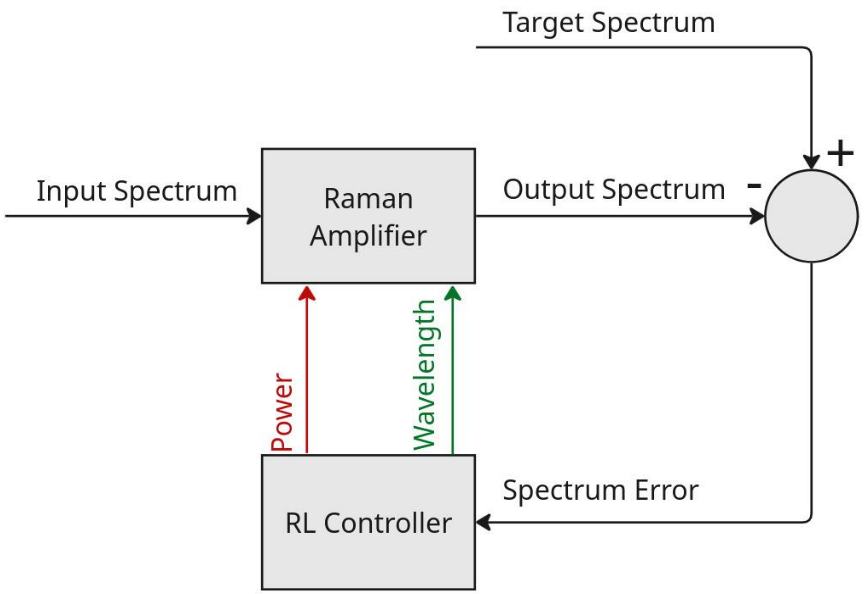
- Forward and Backward Pumps are controlled as a single unit.
- Powers are individually controlled
- Wavelengths are controlled together for each pair

- The optical fiber introduces non-linear losses to the Spectrum
- Compensation of these losses is the goal of Raman Amplification



Reinforcement Learning Control System

- The Raman Amplifier system takes in the input spectrum, pump powers and pump wavelengths as input
- The control goal is for the Output Spectrum to be the same as the Target
- The Input Spectrum is a non-controllable input
- To achieve the Target Output Spectrum, we can control the Pump Powers and Pump Wavelengths



Reinforcement Learning for Control

- RL is a data-driven control method
- The controller is an agent that learns by trial and error
- No explicit model of the system is required (model-free)
- The agent selects actions - system responds - agent receives reward
- Goal - optimize control policy to maximize long-term performance
- Advantage - can adapt to nonlinear, uncertain, or complex systems

- For RL algorithms to control the system properly, proper reward function is needed
- Since our goal is for the Output Spectrum to reach the Target Spectrum, we can use the difference of those spectra as a loss function
- That means we define the Reward Function as negative Loss