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A Deep RL Framework for locking optimization in simulated optical cavities.

This work explores the use of Deep Reinforcement Learning (DRL) to optimize the locking procedure of high-finesse Fabry–Perot cavities, key components of gravitational-wave detectors. Improving and speeding up the lock acquisition process helps increase the detector's duty cycle. This task is challenging due to nonlinear effects such as ring-down and resonance drifts, which distort the optical signals used for control.

To address these difficulties, we develop a simulator of the optical response of a Fabry–Perot cavity and a custom Gymnasium environment that allows a DRL agent (DDPG) to interact with the system and learn optimal locking strategies. Finally, we present some results of several training sessions on different simulated optical cavities, including partial observability and domain randomization, laying the groundwork for SimToReal transfer.

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