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Leveraging Reinforcement Learning for Safe Navigation of Mobile Robots in Accelerator Tunnels

The integration of mobile autonomous robots in accelerators introduces potential risks to the facility itself, including collisions with critical components, cables, and infrastructure. Such incidents could compromise the functionality and safety of the accelerator, necessitating robust solutions to mitigate these risks. This paper explores how Reinforcement Learning (RL) can be leveraged to enable autonomous vision-based navigation for mobile robots while incorporating self-supervised anomaly detection to enhance operational safety. Exemplified by the robotic platform “MARWIN” at the European XFEL, the findings provide an analysis of key factors influencing RL applicability, including adaptability, real-time performance, and training requirements. Concluding with practical implementation suggestions, this work aims to offer a roadmap for leveraging RL to develop safe and reliable robotic navigation systems tailored to the unique needs of accelerators.

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