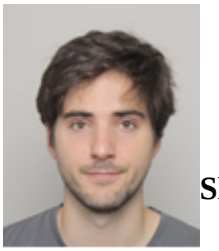
SORS: Harnessing Machine Learning and High Performance Computing in Adaptive Optics for High-Contrast Imaging in the Subaru Telescope

Objectives

Abstract: The new generation of ground-based optical telescopes, classified as extremely large telescopes, are currently being commissioned. These >=30 m diameter telescopes hold the potential to directly image rocky exoplanets in the habitable zone of extrasolar systems only if certain technological challenges are met. A crucial challenge is the real-time correction of the atmospheric distortions on the image, handled at frequencies of 1-2 KHz, a task undertaken by Adaptive Optics (AO) systems.

In this work, we explore the implementation and enhanced performance of different machine learning (ML) techniques to improve the performance of the AO system, as part of the Subaru Coronagraphic extreme Adaptive Optics (SCExAO) team for the 8.2m Subaru telescope in Hawaii. Our approach consists in a pipeline that combines supervised learning and reinforcement learning with offline training and online fine-tuning to adapt to changing atmospheric conditions. To manage the loop frequency, we leverage high performance computing techniques, implementing an ML extension of the Modular Image processing Library toolKit (MILK) package, which enables efficient shared memory communication between processes.



Short bio: Bartomeu Pou is a fourth-year PhD student at the Barcelona Supercomputing Center and Universitat Politècnica de Catalunya. He has an undergrad in physics from the Universitat de les Illes Balears and a master's in Artificial Intelligence from the Universitat Politècnica de Catalunya. His interests lie in Machine Learning, specially Reinforcement Learning and its application to different problems, such as Adaptive Optics.

Speakers

Speaker: Bartomeu Pou Mulet, fourth-year PhD student at the BSC and UPC
Host: Eduardo Quñones, Predictable Parallel Computing Established Researcher, CS, BSC

Barcelona Supercomputing Center - Centro Nacional de Supercomputación

---