



The transformative and critical role of autonomous science operations for current and future facilities

Vanessa A. Moss^{*(1)(2)}, Craig Haskins⁽¹⁾, Zoe Taylor⁽¹⁾, Aidan W. Hotan⁽¹⁾, Kate E. Jameson⁽³⁾, Francois B. Kapp⁽³⁾, Gian Franco Sacco⁽³⁾ and Gregg W. Hallinan⁽³⁾

(1) Space & Astronomy, CSIRO, Australia

(2) University of Sydney, Australia

(3) California Institute of Technology, United States

Alongside groundbreaking new hardware capabilities for existing and future facilities, we are also entering a new era of optimisation and efficiency that will be driven by software innovation. The dramatic rise of practical artificial intelligence in recent years has significant implications for how we effectively operate our future facilities, a trend that has already been in place for years with the general shift towards increasingly automated facility operations.

Considering the specific case studies of the Australian SKA Pathfinder (ASKAP, [1]) and the Deep Synoptic Array (DSA-2000, [2]), we will outline the approach we have taken in moving towards autonomous operations, especially in the realm of scheduling science observations for surveys. Our findings to date show that telescope operations can be highly autonomous even with a relatively low level of AI, freeing up human resources and effort while increasing the overall efficiency of scheduling. We will also explore the concept of collaborative intelligence (CINTEL), which seeks to develop workflows and systems which optimise the contributions of humans and machines for maximally positive outcomes by considering their relative strengths and weaknesses.

We maintain that the true capability of current and next-generation facilities will only be achieved if we adapt the ways in which we operate our facilities, treating the evolution of our operational models as a core and critical part of the technical innovation that will broaden and deepen the parameter space we can explore.

References

- [1] A. Hotan et al., “Australian Square Kilometre Array Pathfinder: I. System Description”, *Publications of the Astronomical Society of Australia*, **38**, e009, 2021
- [2] G. Hallinan et al., “The DSA-2000 — A Radio Survey Camera”, *Astro2020: Decadal Survey on Astronomy and Astrophysics*, *Bulletin of the American Astronomical Society*, **71**, 7, 2019