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Deep Learning: Towards Autonomous Remote Maintenance

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Traditionally, remote maintenance in fusion and other nuclear plants has made use of man-in-the-loop telemanipulator devices in order to deal with the relatively unpredictable nature of tasks, and complex environments. Future fusion devices will require maintenance orders of magnitude more complex than at present, however it is infeasible to scale remote maintenance operations teams linearly with the increase in device complexity.

Combined with increasing demand for productivity it will therefore be necessary to automate large numbers of maintenance tasks, many of which have previously been reliant on human-level dexterity and intelligence. This has previously been infeasible due to limitations of automation technology, however recent developments in artificial intelligence are showing a great deal of promise.

The new and rapidly advancing field of deep learning has developed a number of advanced machine learning techniques which have not only surpassed the performance of previous methods, but also, in some cases, outperform human-level performance in a number of challenging task areas. We present recent developments in deep learning which are relevant to nuclear fusion, as well as a range of research activities which have been taking place at RACE related to deep learning for automation of robotic tasks in fusion environments. We describe how these new techniques are changing what can be considered possible in remote maintenance and how methods for remote maintenance are evolving.

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