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Machine Learning Developments for CLARA

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CLARA is an electron beam test facility being developed in phases at STFC Daresbury Laboratory. The first phase, with up to 35 MeV electron beam energy, has been operated since 2018 for a wide range of accelerator applications. The second phase, presently being installed, will expand the range of applications by taking the beam to 250 MeV energy and via a dog-leg to an experimental station that will feature a new high-power laser. A third phase utilising the 250 MeV beam in the straight-ahead line is also envisaged. Machine learning will play an important role in the future development of the facility, with aims to rapidly deliver bespoke beam properties, to detect and diagnose anomalies, and to provide virtual diagnostics. This paper summarises machine learning developments to date, in the areas of RF breakdown detection, photo-injector laser pulse shaping, and longitudinal phase space shaping. Studies to date have largely been offline or using simulated data but steps towards deployment are also reported.

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