

Quantum Fuzzy Inference in Particle Accelerator Control

Monday, 14 November 2022 16:50 (20 minutes)

Fuzzy Logic is a theory which can model classes of objects that do not have precisely defined criteria of membership in a way to mimic human thinking. Thanks to this capability, fuzzy logic has found great application in the field of automatic control and decision making, explained by the fact that expert knowledge is easily introduced into fuzzy systems, by means of fuzzy rules. Despite their success, fuzzy rule-based systems (FRBSs) suffer from the fuzzy rule explosion problem: the number of rules in a FRBS grows exponentially with the number of variables that makes up the system, limiting the possibility of controlling environments characterized by a high number of variables.

A recently proposed Quantum Fuzzy Inference Engine (QFIE) solves this problem thanks to the parallelism provided by quantum computers. Indeed, it has been proved that by formalizing a FRBS as a Boolean oracle, QFIE requires exponentially fewer queries to the oracle than its classical counterpart.

This talk aims to introduce the peculiarities of QFIE and to show the results obtained in the experimentation carried out at the European Organisation for Nuclear Research (CERN), where QFIE has been tested in controlling particle accelerator beam lines. The results obtained have shown the capability of such a quantum control system in controlling these complex environments.

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Session Classification: Lunedì

Track Classification: Fondazionale