Opportunity of Msci Dissertation (Tesi di Laurea)

Title	Development and implementation of Tools for the Availability and Reliability Assessment of the CERN Complex Technical Infrastructure Systems
Motivations and objectives of the research	CERN operates and maintains a large and complex technical infrastructure that serves the accelerator complex and experiments detectors. A performance assessment and enhancement framework based on data mining, artificial intelligence and machine-learning algorithms is under development with the objective of structuring, collecting and analysing the operation and failure data of the systems and equipment, to guide the identification and implementation of adequate corrective, preventive and consolidation interventions. The framework is designed to collect and structure the data and identify and analyse the associated driving events. Within a previous collaboration between the LASAR research group and CERN, a methodology for identifying fault dependencies among components through the extraction of association rules from a database of alarm messages has been developed. The methodology is based on the representation of the alarm database with a binary matrix and the use of the Apriori algorithm for mining association. Its effectiveness has been shown by means of its application to a large-scale database of alarms generated by various monitoring systems of the zone 8 of CERN CTI. The objective of the present thesis work is: 1. to extend and apply the developed methodology to the identification of functional dependencies in the entire CTI and in particular between critical systems such as cryogenics, electrical distribution and cooling 2. to develop a method that on the basis of the identified functional dependencies and the alarm data is able to model the system dependencies and assess the system reliability 3. to implement the tool in the computer based maintenance management platform or similar computer based platform at CERN to support the operation of the accelerator system and guide via modelling the design of new installations (data driven modelling and optimisation).
Activities	i) Analysis of the information available for the development of the method; ii) Analysis of the possible solution methods; iii) Selection of the most promising solution method; iv) Development of the selected solution method; v) Implementation in INFOR EAM or similar computing / database plateform at CERN; vi) Analysis of the obtained results with some representative use cases to analyse critical systems dependencies and model the conceptual design and improve the reliability of new facilities (e.g. medical or industrial accelerators).
Required competencies and skills	i) Interest in developing innovative algorithms to tackle real applications; ii) Good knowledge of Python programming or a willingness to learn before starting the assignment.

Composition of the research group	Number of Full Professors: 1 Number of Associate Professor: 1 Number of research consultant: 1
Names of the research director	Enrico Zio
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Duration of the dissertation	
Total thesis duration	Approximately 9 Months. At most 1 pending exam.

Starting date: April 2021