Agenda 2030 per lo Sviluppo Sostenibile Sustainable Development Goals, SDGs

Obiettivo 9: Costruire un'infrastruttura resiliente e promuovere l'innovazione ed una industrializzazione equa, responsabile e sostenibile - **Pubblicazioni:**

Catelani, M., Ciani, L., Venzi, M.
RBD Model-Based Approach for Reliability Assessment in Complex Systems
(2019) IEEE Systems Journal, 13 (3), art. no. 8401963, pp. 2089-2097.

Abstract: Nowadays, system reliability performance represents a key issue in any advanced technology application in order to guarantee ambient, personnel, and system safety. The core of this paper is the reliability block diagram (RBD) generation with the aim of providing project engineers a reliability prediction in the early stages of industrial product development. This study is focused on gas turbine auxiliary systems; these systems include both mechanical items (in particular hydraulic devices such as valves, pumps, and filters) and electronic ones (e.g., sensors, instruments, control logic). Such complex structures are decomposed in single blocks and interconnections to establish their mutual relationship and achieve reliability performance of the whole system. The case study is one of the most important gas turbine auxiliary systems, the mineral lube oil console. The aim of this paper is to introduce a new approach to assess system reliability prediction in presence of redundant and stand-by architectures; redundancy is widely used in industrial applications since it is one of the best techniques to achieve fault tolerance. The proposed method led to the development of a dedicated software tool RBDesigner that semiautomatically generates a RBD starting from the sketch of thermal-hydraulic systems and provides the most important reliability parameters. The use of the proposed tool allows project engineers to reduce time delivery, reduce time for improvements, achieve reliability targets, and guarantee availability performance to the customers. The strengths of RBDesigner were finally validated by a comparison with other commercial software solutions.

Catelani, M., Ciani, L., Patrizi, G., Venzi, M.
Reliability allocation procedures in complex redundant systems
(2018) IEEE Systems Journal, 12 (2), pp. 1182-1192.

Abstract : In the last two decades, the reliability assessment acquired a fundamental role in many advanced technology applications where environment, personnel, and system safety are mandatory features. This study deals with reliability allocation (RA) procedures that are top-down techniques that allow apportioning of the system reliability goal between its components. This apportionment of reliability values among the various items making up the whole system is based on estimated achievable reliability, criticality, complexity, or any other relevant factors in the allocation process. In the first part, this paper analyzed the main allocation methods shown in the literature in order to enlarge the range of applicability of these allocation techniques, from series architectures to redundant architectures. In the second section, the RA methods were tested on two case studies in order to extend their applicability in the presence of very complex redundant architectures.

Leturiondo, U., Salgado, O., Ciani, L., Galar, D., Catelani, M.
Architecture for hybrid modelling and its application to diagnosis and prognosis with missing data
(2017) Measurement: Journal of the International Measurement Confederation, 108, pp. 152-162.

Abstract: The advances in technology involving internet of things, cloud computing and big data mean a new perspective in the calculation of reliability, maintainability, availability and safety by combining physics-based modelling with data-driven modelling. This paper proposes an architecture to implement hybrid modelling based on the fusion of real data and synthetic data obtained in simulations using a physics-based model. This architecture has two levels of analysis: an online process carried out locally and virtual commissioning performed in the cloud. The former results in failure detection analysis to avoid upcoming failures whereas the latter leads to both diagnosis and prognosis. The proposed hybrid modelling architecture is validated in the field of rotating machinery using time-domain and frequency-domain analysis. A multi-body model and a semi-supervised learning algorithm are used to perform the hybrid modelling. The state of a rolling element bearing is analysed and accurate results for fault detection, localisation and quantification are obtained. The contextual information increases the accuracy of the results; the results obtained by the model can help improve maintenance decision making and production scheduling. Future work includes a prescriptive analysis approach.