Chapter 17

A Review of Systems Reliability Analysis Using Fuzzy Logic

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ABSTRACT

Reliability is one of the important aspects in product quality that shows efficiency or operation of the product, failure rate, and confidence. When the efficiency of the product is reduced below a desired level, the product is said to have failure. In real world, data collection or access of detailed features of the system is often difficult because of incomplete or unavailable information and probabilistic approach to the conventional reliability analysis. Therefore, to solve this problem, fuzzy set theory is used to evaluate system reliability. This research studies the literature on the reliability of fuzzy systems. Several studies have shown that fuzzy logic method can be more appropriate in comparison with classical methods and mathematical modeling.

INTRODUCTION

One of the challenges of engineering systems is to ensure lower production costs and reduce product design cycle times (Assuming that the equipment is efficient and reliable)(Lacas, Santolay, & Biedermann, 2016). If the market for a product is competitive, improving quality and reliability can lead to competitive advantage. The reliability of a system is defined as follows. “The probability that the components of the system under certain circumstances and over a certain period of time carry out the assigned tasks properly”. Reliability is one of the most important qualitative characteristics of large, complex products.
and systems which plays an important role in evaluating the goals and their current status. Today, this discussion has been accepted as an absolute necessity in all aspects of the application. Therefore, it is necessary to evaluate the reliability of complex engineering systems and assess the probability of successful operation and predict their durability which requires the use of appropriate methods (Calixto, 2016).

Reliability is an intrinsic attribute of each product and today it is one of the measurable quantities of design, construction and operation that should always be considered as an important criterion during relevant processes (Naess, Leira, & Batsevych, 2012; Ahmed, & WeiWu 2013). However, in real-world issues, data collection or system-specific features are often difficult to quantify because of incomplete, unavailable, and potentially unreliable reliability analysis therefore, in order to solve this problem, fuzzy set theory is used to evaluate the reliability of the system. The reliability of a product show successful operation, the absence of product failure, the degree of trust and confidence.

RELIABILITY AND FAILURE RATE

Reliability is one of the important aspects of product quality that Murphy (2000) define reliability as follows:

The reliability of a product (system) is likely the product will carry out its mission for a specified period of time under environmental or normal conditions. Also reliability has several definitions:

- The suitability of a device for a purpose at a specific time.
- The capacity of the system or equipment to carry out the mission for which it is designed.
- Resistance of the system or device to failure.
- The probability that the unit in operation will be able to perform the desired task in a timely manner.
- System capability for low cost failure.

Reliability is strongly dependent on the concept of failure. Many products will decline with increasing age and use and this naturally affects the reliability of the product. When the performance of the product falls below optimal levels then the product is called failure. The two definitions of failure are:

1. To finish the ability of a component to perform the required task (IEC50 (191), 1990).
2. Equipment failure is that the equipment is not capable of performing its intended operation under specified operating conditions for which it was designed (Nieuwhof, 1984).

Also the technical reliability is defined as follows (IEC60050-191, 1990): The ability of a component to perform the required task under the terms for a given time period.

Fuzzy Logic

Fuzzy Logic was first introduced in 1965 by Zade (Zadeh, 1965). Fuzzy logic lies in the case of binary logic, which has only two zero and one propositions. There are propositions in the interval between zero and one and express the degree of membership to a given set. Analysis and modeling of systems
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