Innovative Applications in Smart Cities

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Contents

CHAPTER-18

Weibull Reliability Method for Several Fields Based Only on the Modeled Quadratic Form

Manuel R. Piña-Monarrez[1,*] and *Paulo Sampaio*[2]

In this chapter, a practical and dynamic method to determine the reliability of a process (or product) is presented. The novelty of the proposed method is that it let us to use the Weibull distribution to determine the reliability index, by using only the quadratic form of the analyzed process (or product) as an input. So, since this polynomial can be fitted by using, e.g., simulation, mathematical and/or physical modeling, empirical experimentation and/or any optimization algorithm, the proposed method can easily be implemented in several fields of the smart manufacturing environment. For example, in the industry 4.0 framework, the proposed method can be used to determine, in dynamic form, the reliability of the analyzed product, and to give instantaneous feedback to the process. Therefore, to show the efficiency of the proposed method to determine the reliability in several fields, it is applied to the design, the quality and the monitoring product phases as well as to the fatigue (wearout and aging) phase. In order to let readers adapt the given theory to their fields and/or research projects, a detailed step by step method to determine the Weibull parameters directly from the addressed quadratic form is given for each one of the presented fields.

1. Introduction

Nowadays smart manufacturing (*SM*) is empowering businesses and achieving significant value by leveraging the industrial internet of things. Therefore, because process and products are now more complex and multifunctional, more accurate, flexible and dynamic analysis' tools are needed in the *SM* environment. For example, these technical tools are now being implemented into the industry 4.0 framework to evaluate and to make instantaneous feedback in the *SM* environment. Therefore, in this chapter a method to determine and/or to design a product or process with high reliability ($R(t)$) is presented. More importantly, since the proposed method is based on the Weibull distribution [1], then based on its Weibull shape parameter (β), the proposed method allows us to evaluate the reliability of the process or product in either of their principal phases; to know the design phase, which occurs for $\beta < 1$, the production phase which occurs for $\beta = 1$, and the wearout and aging phase which occurs for $\beta > 1$ [2]. Hence, due to the flexibility given by the β parameter, the proposed method can be used in the *SM* environment to evaluate in dynamic form the reliability of any *SM* process for which we know the optimal function.

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