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On the reliability of Gaver's parallel system supervised by a safety unit

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ABSTRACT We analyse the reliability (survival function) of Gaver's parallel system supervised by a safety device and attended by two heterogeneous repairmen. For safety reasons, no unit is allowed to operate without supervision. Our methodology is based on the theory of terminating renewal processes. As an example, we consider the case of Erlang repair and we derive the corresponding survival function.

Keywords: parallel system, safety device, stopping time, Erlang repair, reliability

1 Introduction

An important engineering duplex system with tantalizing industrial applications, e.g. [12], is Gaver's parallel system[7]. The system, henceforth called the G-system, consists of two units operating in parallel, called **G**-units, attended by a single repairman. The **G**-system acts as a closed queuing system, i.e. any failed unit goes immediately into repair unless the repairman is already occupied. In this case, the failed unit has to queue for repair. On the other hand, any repaired unit becomes immediately active (operative). The **G**-system is down if both **G**-units are down. The **G**-system is totally up if both **G**-units are up (operative) and partially up if only one **G**-unit is up.
The **G**-system has received considerable attention with regard to reliability, availability, safety and risk analysis. A concise survey has been presented in [17]. A large list of references has been compiled in [9]. A statistical generalization, characterized by general distributions for failure and repair has been proposed by Ohashi and Nishida in [10] (case of homogeneous units) and in [21](case of dissimilar components). Tangible variants of the **G**-system, for instance characterized by cold or warm standby have been introduced in [2],[11],[13],[16],[19],[20].
As a new variant, we consider the **G**-system supervised by a repairable safety device, henceforth called the the **S**-system, respectively the **s**-unit.The **S**-system is subjected to "dormant" states, i.e. for security reasons, no **G**-unit is allowed to operate without supervision of the **s**-unit. Thus, any failure of the **s**-unit implies a shut off of the **S**-system being in any of the up-states (totally up or partially up) leading to a "dormant" state (shut off state) until the repair of the **s**-unit has been completed. A similar shut off rule applies to the **s**-unit, i.e. upon failure of the **G**-system the operative **s**-unit is put in a dormant state until a **G**-unit has been repaired. In addition, we assume that the **S**-system is attended by two heterogeneous repairmen R and R_s. Repairman R is skilled in repairing failed **G**-units, whereas repairman R_s is supposed to be an expert

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