

Recent Advances in Multi-state and Continuous-state System Reliability

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Classical reliability theory is devoted to traditional binary reliability models allowing only two possible states for a system and for its components: perfect functionality (Up) and complete failure (Down). However, many real-world systems can perform their tasks with various distinguished levels of efficiency usually referred to as performance rates. A system that can have a finite number of performance rates is called a *multi-state systems (MSS)*. The examples of MSS are, for example, power systems or computer systems where the component performance is characterized by generating capacity or data processing speed respectively. For the MSS outage effect will be essentially different for units with different performance rates. Therefore, the reliability analysis of MSS is much more complex in comparison with binary-state systems. In real-world problems of MSS reliability analysis, the great number of system states, that need to be evaluated, makes it difficult to use traditional binary reliability techniques. In practice some systems and components also can exhibit continuous performance. In these cases one can discern a continuum of different states varying from perfect operation to complete failure. So, a class of structure functions was introduced in which the performance of each state may take any value in the closed interval. Such functions are called as continuous structure functions and corresponding systems are called as *continuous-state systems (CSS)*.

From the middle of seventieths up to now numerous research works focused on MSS reliability were published. MSS extension of classical binary-state reliability theory was intensively developing during this time. More than 500 scientific papers in the field were published from that time; special sessions devoted to MSS reliability were organized on international reliability conferences (MMR, ESREL, etc). The evidence of increasing interest to this problem is also the fact that at last time some books completely or partially devoted to this problem were published. Additional experience was also accumulated in industry. In opposite to MSS, till now very few research works were devoted to CSS.

In the talk we present a brief overview of the field and basic concepts, define MSS and CSS reliability measures and systematically classify modern tools for MSS and CSS reliability assessment and optimization.