

MATHEMATICAL THEORY OF RELIABILITY IN ENGINEERING AND BIOLOGICAL ROBUSTNESS: A LITTLE BIT OF HISTORY AND THE STATE OF ART

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The foundations of the mathematical theory of reliability were laid in the 1950s due to the needs of aeronautic machinery and problems of communication, management, etc. Reliability is defined as the ability of a device to perform the preset function for the given time under the given conditions [1]. Like in engineering, each and all biological systems are devices constructed to perform the preset functions according to the information planes, i.e. – the genetic programs. Similarly to technical devices, biological constructs are not perfectly reliable in operation, i.e. – for each and every device normal acts of operations alternate with stochastic (random) malfunctions or failures. The problem of reliability of biological systems was first put forward by D. Grodzinskiy and his collaborators [2]. The regular conferences on bioreliability, starting from the first one in 1975, Kiev, former USSR, have given a strong impetus to research in this direction. The special Committee on Reliability of Biological Systems at the Scientific Council on Biological Physics of the USSR Academy of Sciences, to deal with the problems of reliability of biological systems, was organized in 1978, and many prominent biophysicists were the members of this Committee. A quarter of a century after, it has spurred the similar studies behind the former iron curtain under the style of “robustness” [3]. Meanwhile, there is no a theory of robustness but the mathematical theory of reliability. Therefore, reliability, not robustness, is universally accepted as the term in engineering and, correspondingly, it has been used in the pioneer works on bioreliability. Here, I present the results of application of the reliability approach to the problem of aging. Aging occurs as the inevitable consequence of the genetically preset deficiency in reliability of the biomolecular constructions while the free-radical redox-timer, located in the specialized cells of central nervous system, serves as the effective stochastic mechanism of realization of the program [4, 5]. Furthermore, the systems reliability approach serves as the heuristic methodology for preventive medicine, including the antioxidant therapy.

References

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