Fault diagnosis and fault-tolerant control meet increasing demands of modern control systems of increasing complexity. They give an ability to detect, isolate and determine size of a subsystem fault before it will transform into a failure and then to minimize its impact as well as ensuring predefined quality demands regarding its performance. Taking into account a significant number of sensors and actuators present in modern control processes, this is not a trivial task. The main reason behind such a situation is the fact that there are various interaction between the above equipment as well as the fact that their immediate replacement with non-faulty counterparts is, in most cases, impossible.

Another important aspect is the *remaining useful life of subsystem components*, which has a crucial influence on the entire complex system reliability. Inappropriate exploitation of subsystem actuators associated with scheduling of a complex system may lead to their premature failure. As a remedy, the idea of virtual actuators is proposed, which boils down to using the nominal controller and the modifying the control strategy of all actuators (including faulty ones) in such a way as to compensate the fault effect. Realization of such a task requires precise knowledge about a diagnostic state of particular subsystem components, i.e., sensors and actuators responsible for performing a required mission of the subsystem.

In the available solutions, sensor fault diagnosis is designed under an assumption that all actuators are fault-free. A similar approach is realized in case of virtual actuators. In the project, it is proposed to eliminate this assumption and to start a pioneering research in the direction of simultaneous determination of sensor and actuator fault size. Another research goal is appropriate fault compensation, which requires knowledge about current control abilities of the system. This task rises a chain of nontrivial scientific problems, which remain unsolved so far. To solve them, within the project framework, it is proposed to apply advanced analytical approaches. Another step of the project is to use the knowledge about the current diagnostic state of subsystems to estimate the remaining useful life of their actuators. This task is usually realized with dedicated equipment, which significantly increase the overall cost of a complex system. Elimination of this equipment enhances the accessibility of techniques for control and estimation of actuator remaining useful life. This research results are to be applied to develop scheduling strategy of a complex system, which will make it possible the extend the remaining useful life of its subsystem actuators.

The project covers development of theoretical tools with possibly universal structure, which makes it possible to apply them for various types of complex systems. Undoubtedly, the wide accessibility of the proposed solutions will stimulate the scientific developments in this direction and minimization of energy consumption and failure rate of the currently performing systems. Additionally, the project will constitute a few long term economical benefits such as increasing the reliability of the systems under fault-tolerant control, longer lifetime of subsystem actuators, shortening the break-down times, lengthen the periods between maintenance services, decreasing overall lifetime costs, boost the safety of operators decreasing potential insurance costs. Furthermore, the project raises fundaments for the future practical research in industrial fault-tolerant and will bring the Polish science society even higher in the world’s ranking.