Statistical data proves, that vast majority of industrial related energy is the one consumed by electrical drives. Ability of control of position, speed or electromagnetic torque with changing control unit parameters and greater drive precision requirements, require usage of complex converter drives. The need to use complex in the construction of electric drives increases the probability of their failure. In addition, mechanical load (high dynamics) and electric stress (sudden changes in voltage and current) directly affect the damage to the motor. All of the above, combined with contemporary trend to increase efficiencies, and therefore the continuity of production makes that fault tolerant control (FTC) are becoming an attractive solutions. What is more, early detection of faults in systems, where high reliability is required may prevent against dangerous damage or disaster, which may cause huge cost, even human lives.

Increasing demand for the reliability of the control systems of the industrial and communication devices, especially the control systems of electric drive can be observed in recent time. Most of classic significant solutions are not adjusted to systems, where safety is a major priority. The reliability of electric drives is an important factor that determines competitiveness of manufacturing machines and robots. From this perspective it seems reasonable to look for solutions able to minimize the electrical drive failures.

Available research works related to electric drives focus on induction motor drives. These researches are conducted only for steady state of the drive system. There are no available research works presenting fault-tolerant control methods applied to real electric drive, that can meet the demands for good static and dynamic parameters.

Permanent magnet excited motors are widely use in precise drives of robots and mechanic tools. The main advantages of these motors are: high power to dimension ratio, operation in wide range of speeds and very good dynamic parameters. High efficiency of energy conversion in permanent magnet excited motors causes that these machines are more and more popular also in different classes of industrial drives. Although, the domain of its application is formed mainly by the drives with the highest requirements for reliable operation.

The research project hypothesis is an overall design of fault detection and isolation methods (FDI), which can ensure appropriate monitoring and classification of faults in an electric drive with permanent magnet synchronous motor (PMSM) to implement fault tolerant control methods (FTC). Achieving this purpose requires solving research issues consisting of development, analysis and evaluation methods of detection, isolation and identification of faults in real time (“on-line”) for chosen structures and control algorithms providing best behavior of the drive unit, for adopted criteria, in case of a fault occurs.

Diagnostic system should, with a required degree of precision, differentiate the faults and states of the object. Ability to perform such differentiations depends on the characteristics of diagnosed object. To achieve the best possible detection results, it is vital to design a proper set of detection algorithms.

Proper detection phase consisting of generating and evaluating residuum values involving conversion of quantitative residuum signals to qualitative diagnostic signals along with decision making process of defect symptom detections, forms a base to create methods of detailed fault localization and identification. Within the framework of the project two method groups of fault detections will be developed and adapted: data analysis and methods including process model.

Research will focus on theoretical considerations and simulation analysis. Signal models, that describe functional relations, and circuit models, that allow to deepen the analysis of physical phenomena will be used. A database containing description of typical damages of permanent magnet synchronous motor drives and methods of detection, isolation and identification of the faults will be created at the first stage. In the second stage of the study simulation results will be verified on a laboratory stand.

The work conducted will develop a variety of methods of detection, isolation and identification of faults in electro-mechanical systems. These methods are universal and can be used for other objects. Developed diagnostic algorithms allow the introduction of fault tolerant control, which will provide drive operations such as in nominal terms or safe operation of properties reduced and will replace the periodic inspections with repair only those elements for which it is actually necessary. Moreover, early detection of faults in the systems of the required high reliability can prevent dangerous failure or disaster, costing human lives or causing significant losses.