DESCRIPTION FOR THE GENERAL PUBLIC

The phenomenon of fatigue lies in a slow loss of material's mechanical properties caused by applying variable load over time which results in so called fatigue failure. The phenomenon is widely observed on metals and its alloys as well as several plastics and composites. Despite many research studies the fatigue mechanism has not yet been fully understood. The researchers assume that with proper load every cycle of external stress creates localized plastic strains. These are visible under microscope in forms of slip bands and twins. They propagate with an increasing number of stress cycles and bind together causing a fatigue failure.

Scientists are also interested in a macroscopic, phenomenological aspect of the fatigue phenomenon which becomes even more interesting when considered in relation to algorithms determining fatigue life. Therefore, when proposing the algorithms, the researchers consider a wide spectrum of factors affecting material durability, such as type of the material, condition of its surface and above all the nature of applied load.

The objective of the presented project is to examine how endurance is affected by a probability distribution shape history of random ranges of a load. The knowledge is essential to creating reliable algorithms determining fatigue life in time and frequency domains. In particular, spectral algorithms functioning in the frequency domain are sensitive to deviation from the presumed normal distribution.

The project will be carried out in two stages. In the first stage a base of theoretical problems will be prepared which will allow the researchers to discover functional dependencies between a normal load distribution and a distribution with altered parameters. The parameters to be altered are: kurtosis, skewness as well as normal and central moments of higher orders while considering deviations from the normal distribution.

The second stage – research – is a detailed analysis of changes of the fatigue strength resulting from modified load range. A series of fatigue tests will be conducted on circular specimens made of aluminum alloy and circular specimens made of steel. The specimens will be subjected to tests with random loads in Gaussian distribution as well as tests where proposed range modifications to loads distribution will be applied.

The results of the conducted research will positively affect effectiveness and reliability of algorithms determining fatigue limit. The obtained results of the research study will considerably broaden and popularize the state of the art in the field of fatigue, fracture mechanics, materials engineering, stochastic, control systems, modelling and experimental research planning.