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**Project Title:** Numerical and experimental study on fatigue life improvement of gas turbine blade via shot-peening method

<b>Department:</b>	Mechanical rotating equipment	<b>Employer:</b>	Niroo Research Institute
<b>Project Manager:</b>	Saeid Sahmani	<b>Executor:</b>	Ehsan Tavakoli
<b>Project Financial Code:</b>	929400	<b>Project Quality Code:</b>	PMEPN30
<b>Type of Project/Program:</b>	Interior	<b>Assistant:</b>	Research

**Project Staff:** -

**Keywords:** Fatigue life; Residual stress; Mechanical surface treatment; Crack growth; Gas turbine blade; Finite element method; Impact velocity

### Project Necessity:

Nowadays, with the aid of mechanical surface treatment technologies, the life of different power plant parts can be improved. One of these technologies is the shot peening one, in which the compressive surface residual stress is created via impacting of small shots on the free surface of a part in order to improve its fatigue life and to decrease the rate of crack growth. According to this point that the required facilities for using this technology are available in country, in this project, experimental and numerical study on employing of this technology to improve the fatigue life of gas turbines is performed.

### Project Goals:

In this project, in order to study comprehensively about the knowledge of shot peening technology for using in the power plant industry, numerical and experimental study on this technology using for improvement of fatigue life of gas turbine blades is conducted. For this purpose, the shot peening process and the impact of shots on the free surface of a component are simulated, and the effect of it on the reduction of crack growth length is investigated both numerically and experimentally.

### **Abstract:**

The shot peening process as one of the most applied technologies to improve the fatigue life of several components in various industries such as aerospace, power plants, etc. is an important technology in industrial countries. Using of this technology is essential in different companies. The shot peening process is utilized to enhance the stiffness of components against fracture mechanism. When a component contains cracks on its free surface, it may be fractured under cyclic loading conditions. With the aid of shot peening technology, a compressive residual stress is applied on the free surface of a component which causes to eliminate the additional tensile stress coming from the surface cracks, and the surface atoms tend to be under compression.

In this project, the shot peening process on a part made of the superalloy using in gas turbine blades is simulated via the finite element method, and the influence of different parameters on the value and depth of the created compressive residual stress is analyzed. After that, with the aid of the both developed numerical model and fatigue crack growth experiment, the fatigue behavior of the shot peened components are investigated.

### **Steps and Methodologies:**

First step: Simulation of shot peening process using finite element method

Second step: Simulation of fatigue behavior and fatigue crack growth rate of shot peened samples with the aid of the developed numerical model

Third step: Fatigue experiment on shot peened samples and indicating the fatigue crack growth rate experimentally and comparing with that obtained by the numerical simulation

### **Main Results (technical outputs, patents, papers, books, reports, etc.):**

3 technical reports

1 ISI paper