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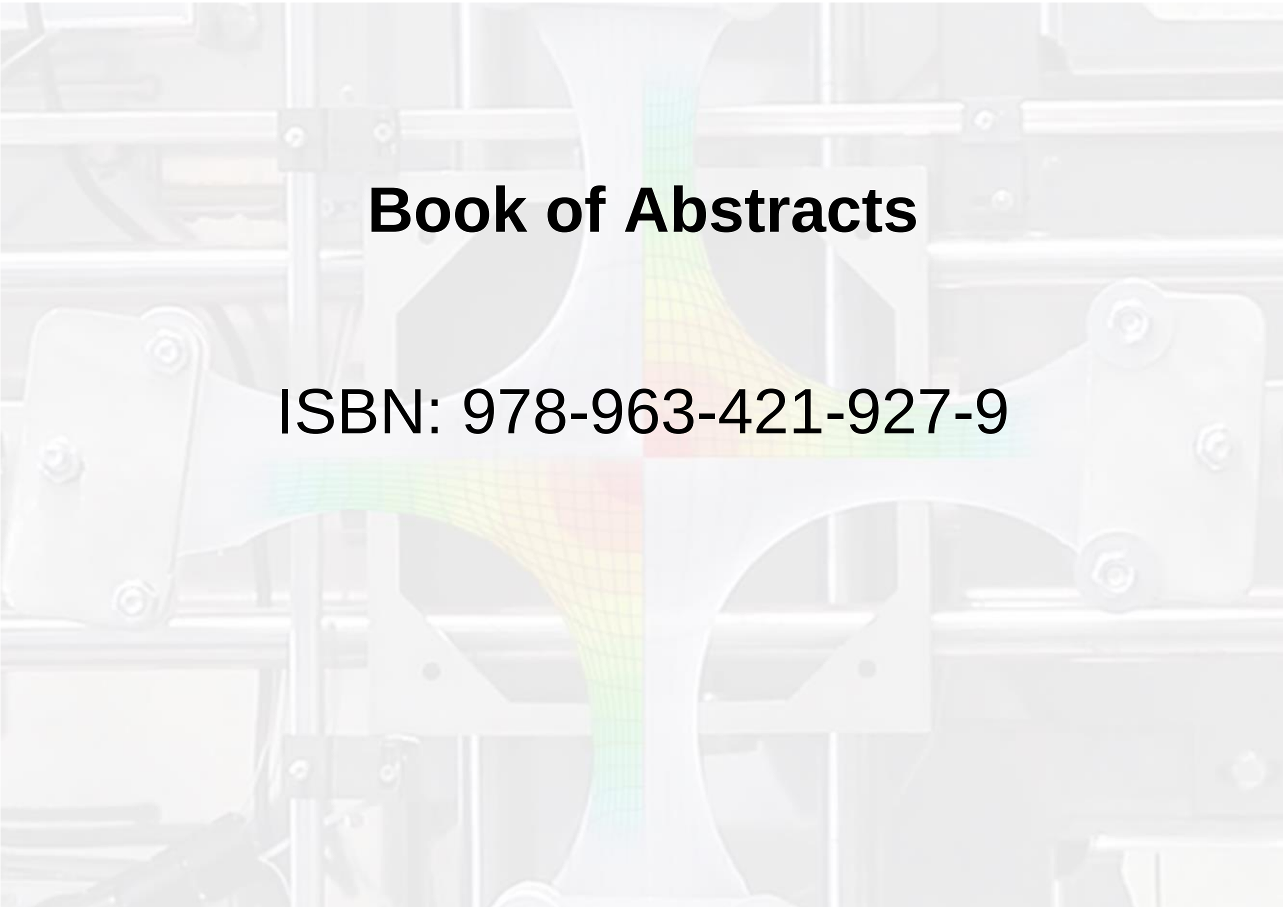

Book of Abstracts

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About the Symposium

The Danubia-Adria Society on Experimental Methods (DAS) was founded in 1983. The objective of the Society is "to promote experimental mechanics, covering all aspects from the development to the applications of the methods, for the quality improvement of products and processes and for developing new models of education".

To achieve this purpose the Society intends to: encourage exchanges of teachers and researchers between universities and other technical and scientific societies; develop areas of technological cooperation between researchers and technicians from different countries on bilateral and multilateral basis to contribute to the mutual scientific benefit; organize every year an Annual Symposium on "Development of Methods and Applications of Experimental Mechanics"

The Symposium is mainly focused on experimental mechanics and therefore we expect contributions which contain any experimental mechanics technique in the scientific analysis. The main categories are:

- Structural analysis
- Material modelling
- Biomechanics
- Instrumentation
- Numerical methods combined with experimental mechanics
- Industrial projects

DEVELOPMENT OF AN SOFTWARE APPLICATION FOR POST-PROCESSING OF EXPERIMENTALLY OBTAINED FATIGUE PROPERTIES OF METALLIC MATERIALS

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1. Introduction

There is no exact data, but many books and scientific articles have suggested that 50% to 90% of all mechanical failures are fatigue failures. Fatigue tests measure the resistance of materials to damage, losing strength and failure under the repeated application of load [1].

The main idea of this paper is to develop a software solution for post-processing of experimentally obtained fatigue properties of metallic materials in accordance with the appropriate standard for statistical analysis ASTM E739-91 [2], using the Python programming language with appropriate libraries.

2. The concept of a software application

The software application for post-processing of experimentally obtained fatigue properties was developed in the Python 3.10.7 programming language [3]. Beside to the standard libraries, additional libraries (NumPy, pandas, matplotlib, tkinter) were used for working with data, drawing graphics, creating a graphical user interface, and Visual Studio Code software [4].

The idea of a general algorithm program for post-processing of experimentally obtained fatigue properties is as follows:

- All obtained results of the experimental tests are collected in an Excel file performed in accordance to ASTM E468-90 standard [5].
- Starting the application is done by running the *.exe file.
- Step 1 is choosing the type of analysis low cycle fatigue or high cycle fatigue.
- Step 2 is to select the appropriate Excel document. For low cycle fatigue, the table contains the following data: modulus of elasticity E, number of the sample, and their values of total strain amplitude ε_a, stress amplitude σ_a and number cycles to failure *N*. For high cycle fatigue, the table contains the number of samples, stress amplitude σ_a and number cycles to failure *N*.
- Step 3 is the display of the obtained fatigue properties. For low cycle fatigue: fatigue strength coefficient σ_f', fatigue strength exponent *b*, fatigue ductility coefficient ε_f', fatigue ductility exponent *c*. For high cycle fatigue: fatigue strength coefficient σ_f', fatigue strength exponent *b*, Slope of fatigue strength curve *m*.
- Step 4 is plotting of corresponding *ε-N* and *S-N* curves in semi-log or log-log representation with all results of the experimental tests.

3. Visualization of a software application

Starting the program (*.exe file) opens the window shown in Figure 1., in which it is necessary to select the type of fatigue properties

Fig. 1. Main window of software application

By selecting one type of fatigue assessment, a new file selection window opens. Selecting a file opens a new window, which offers the option to start a program for post-processing the data of the loaded file, prepared in accordance with ASTM E468-90. By loading the data from the selected file, the calculation procedure of the appropriate fatigue properties of the material is started in accordance with ASTM standard: E739-91. Results of obtained fatigue properties are shown in Figure 2.

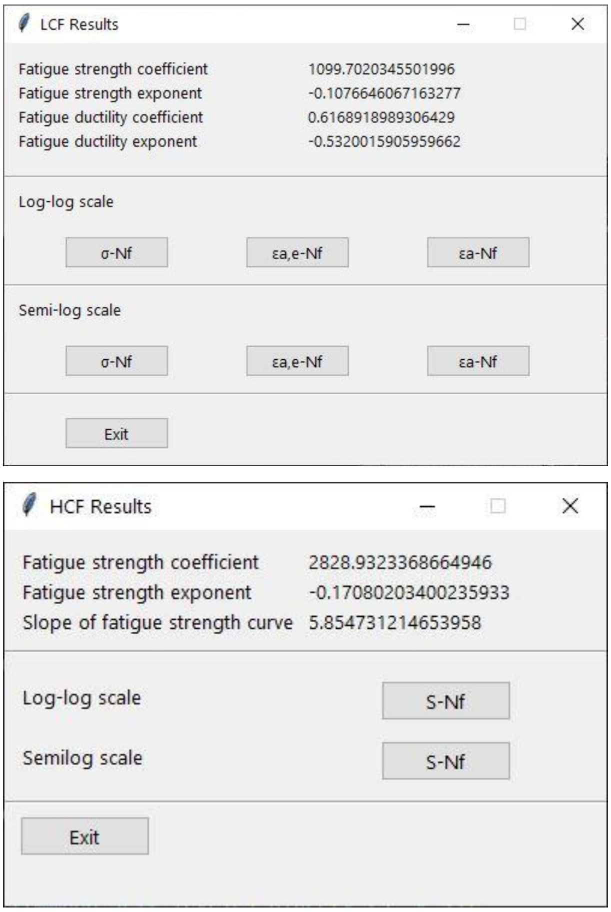

Fig. 2. Obtained fatigue properties, window with results

On windows shown in Figure 2 user is enabled to plot different types of *ε-N* curves and *S-N* curves. *ε-N* and *S-N* curves can be represented in semi-log or log-log form with all results of the experimental tests.

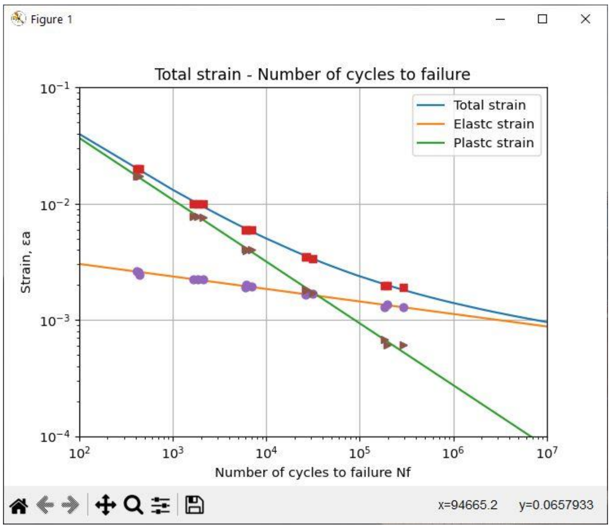

Fig. 3. *ε-N* curves

Figures 3. and 4. present *ε-N* curves in log-log representation and *S-N* curves in semi-log representation as results of using the developed software application for the determination of fatigue properties of metallic materials, respectively.

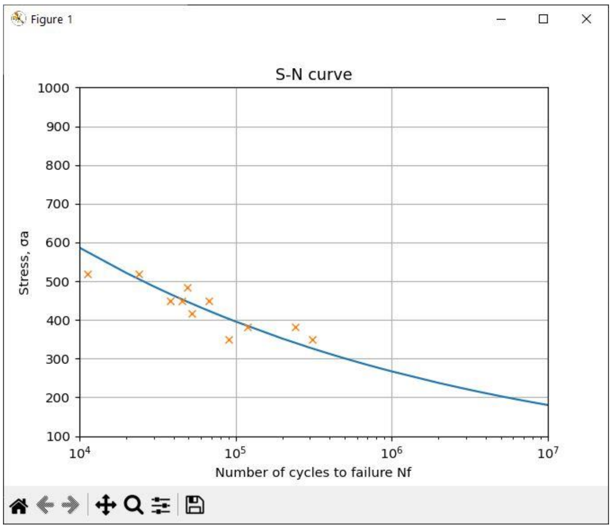

Fig. 4. S-*N* curves

4. Conclusions

The paper has presented a very useful developed software application for the determination of fatigue properties of metallic materials in accordance with standard ASTM E739-91, using the python programming language. As a result, the user is enabled to display the corresponding fatigue properties of the tested material as well as the corresponding *ε-N* or *S-N* curves.

Acknowledgments

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