TMF calculator
User Documentation

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1 Introduction

The following text describes features and functions of TMF calculator, the MATLAB script package intended for predicting thermomechanical fatigue in high-cycle and low-cycle fatigue region. The document gives information about configuration process and main concept of the prediction methodology, which is according to work published by Nagode et al. in [1, 2].

2 Licensing

The provided source codes can be used, modified and distributed for any purpose and free of charge. The authors are not liable for any damage or data loss caused by using this program.

3 Installation and configuration

There are no special steps or prerequisites required for installation, except MATLAB environment. The package can be extracted in any user directory. Scripts can be executed within MATLAB environment only. The main executable scripts are *Nagode_HCF.m* and *Nagode_LCF.m*. Before execution, their header part has to be modified according to specifications of the solved problems.

4 Basic concept of the implemented fatigue prediction models

The main concept of the thermomechanical fatigue prediction model suitable for high-cycle fatigue predictions is schematically shown in Fig. 1. Local stress and temperature histories are needed as input to the model. In every time instant, mean and amplitude of stress is identified by a unique procedure. Mean stress correction is then applied for calculating equivalent stress amplitudes. Linear damage accumulation is then applied, respecting the material temperature dependent S-N curves.

Procedure for low-cycle thermomechanical fatigue applies similar concept. The material temperature dependent e-N curves are recomputed by using a suitable damage parameter. The original proposal of the methodology assumes application of the uniaxial SWT model. Similar stress and strain procedure as in high-cycle fatigue case is used for evaluating mean and amplitude values for every time instant. Linear damage accumulation is assumed.

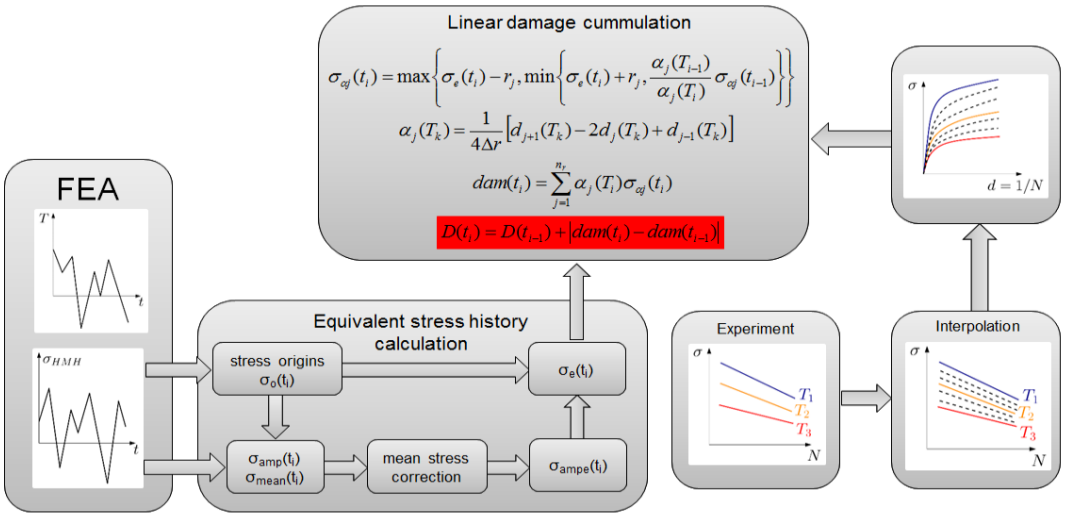

Fig. 1: Scheme of high-cycle thermomechanical fatigue damage estimation by using TMF calculator.

5 User input

For high-cycle fatigue version, user has to specify a set of temperature dependent isothermal fatigue tests. Script computes coefficients of the Basquin relation automatically. For the purpose of equivalent amplitude calculation, fatigue limits in fully reversed and repeated tension are needed.

The low-cycle fatigue version accepts only coefficients of the Basquin and Manson-Coffin models for each low-cycle isothermal e-N curve.

In both versions, user has to supply a set of temperatures, for which fatigue curves are to be interpolated. Temperature, stress and strain history in a local point must be transferred in a text file with tabular format.

6 Acknowledgement

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References

[1] Nagode, M., Hack, M., Fajdiga, M.: *High cycle thermo-mechanical fatigue: Damage operator approach*, Fatigue Fract Engng Mater Struct 32 (2009), 505–514.

[2] Nagode, M., Hack, M., Fajdiga, M.: *Low cycle thermo-mechanical fatigue: Damage operator approach*, Fatigue Fract Engng Mater Struct 33 (2009), 149–160.