Loading Rate Dependency of SERR During Fatigue Experiments

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Relevant Working Groups: WG2

Objectives / Description / Main outcomes

- The purpose of this Short-Term Scientific Mission is to explore the effect of the loading rate at the crack tip under low cycle fatigue experiments. The objective is the calibration of the crucial parameters of fatigue loading, f, R, for two otherwise independent experiments. This is achieved through modification of the Smiley's equation to account for the loading rate at the crack tip under fatigue loading.
- Prior to the beginning of the fatigue experiments on each specimen a quasi-static test is done in order to avoid any sudden crack jumps at the very initial crack length. After this quasi-static test, a new one is conducted in order to acquire the δ_{max} value of the upcoming fatigue experiment. This procedure is repeated till the last fatigue experiment of the specimen. Acquisition of the crack length is achieved through a camera.
- From the reference experiments it is noticed that experiments utilizing R=0.8, f=5 Hz and experiments utilizing R=0.2, f=1 Hz have similar loading rates at the crack tip something also noticed from the calculated frequency which fluctuated from 1 to 1.5 Hz. The modified Smiley equation, to account for fatigue loading, showed a more intense dependency on the range of the deflection and frequency than the maximum deflection itself and initial crack length. For the Reference Experiments, a large deviation exists in terms of loading rate at the crack tip for experiments utilizing R=0.2, f=5Hz and R=0.8, f=1 Hz. After calibration of the experiments results of the loading rate at the crack tip converge. The bridging effect widely affects the results in terms of SERR and sometimes even more than the R-ratio effect. The use of the maximum SERR or the mean SERR widely affects the results in terms of SERR.

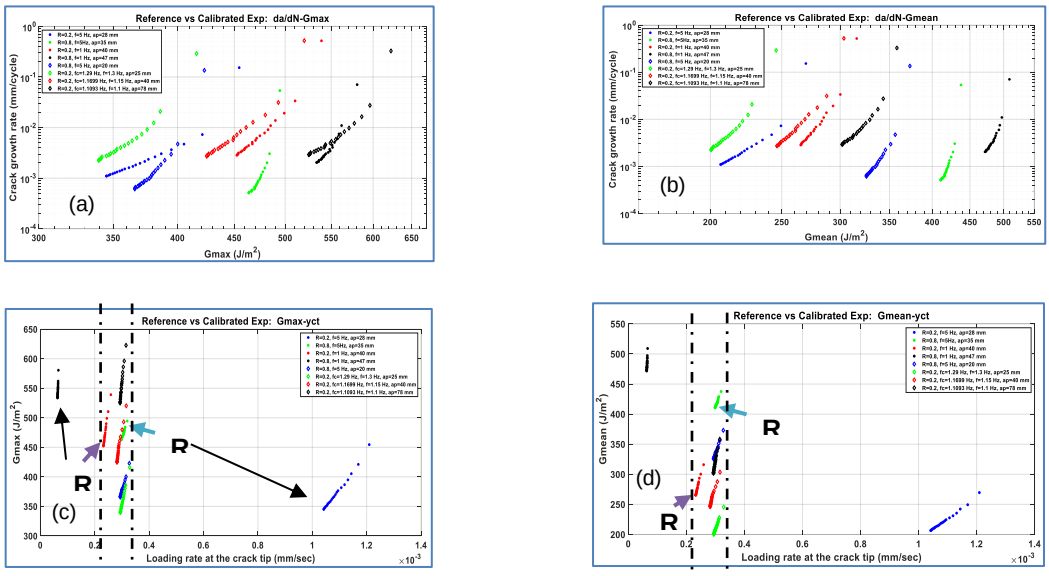

Figure: (a) Crack growth rate vs the maximum SERR and, (b) the mean SERR, (c)maximum SERR vs the loading rate at the crack tip, (d) mean SERR vs the loading rate at the crack tip

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