Fatigue damage staging and crack advance monitoring in space constructions under combined loading

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The fatigue damage staging and crack advance monitoring for space construction are studied for combined quasi-static, dynamic and very-high cycle loads analyzing the damage induced roughness in the process zone (PZ) and fracture surface pattern depending on the load history. Very high fatigue load that is typical for space constructions is characterized by the extended range of damage staging revealing characteristic pattern on the fracture surface related to small crack initiation, transient regime of small crack growth up to the so-called Paris crack length and the propagation of this crack in damaged material. The roughness pattern gives important data concerning accommodation of material to the defect kinetics. Non-destructive testing is proposed based on the roughness analysis to estimate scaling invariants (the Hurst exponent) as the structure sensitive parameter in kinetic equation for damage (defect density) parameter and power exponent in the generalized Paris law. The monitoring of space construction will be realized by the replica technique for surface crack and fracture surface analysis using the laser microscopy by MIM-320 original set-up. To decrease the level of coherent microscopy noise the original technique of difference frames was proposed.

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