Determination of Mode I Stress Intensity Factor Based on Symplectic Geometry Method (Post-print)

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Abstract

To obtain high-precision mode I stress intensity factors, a method based on symplectic geometry for determining mode I stress intensity factors at crack tips is proposed. By constructing a sector region at the crack tip, separating the full state vector at the crack tip under the symplectic geometry framework, and combining it with the displacement field at the crack tip, the stress intensity factor of the crack is calculated. Using the theoretical solution for the displacement field at a mode I crack tip, the influence of the number of characteristic points in the sector region, the central angle size, and the radius length on the accuracy of the stress intensity factor was investigated. The research results indicate that: the number of characteristic points has a significant influence on the accuracy of mode I stress intensity factor solutions obtained by this method; when the number of characteristic points exceeds 37, the relative error stably tends to zero; the sector central angle has a minor influence on the accuracy of the stress intensity factor, but under the same accuracy requirements, different sector central angles require different numbers of characteristic points; when the sector radius is too small, due to the influence of the plastic zone at the crack tip during fracture, the solution for the stress intensity factor becomes unstable and the relative error is relatively large. By comparing the relative errors, it can be found that the mode I stress intensity factors calculated by this method exhibit high accuracy, and this method only requires the displacement field at the crack tip to accurately obtain the stress intensity factor, thus addressing the problem of complex solution procedures in previous solution systems under complex stress conditions that made it difficult to accurately obtain mode I stress intensity factors.

Full Text

Preamble

The manuscript contains severe textual corruption, with only mathematical placeholders remaining intelligible. The remaining content consists of encoding artifacts and watermark text that cannot be meaningfully reconstructed.

Note: Figure translations are in progress. See original paper for figures.