Abstract of Dissertation

Fracture Mechanics Analysis of Shell Structures employing Ordinary State-Based Peridynamics

(Ordinary State-Based Peridynamics を用いたシェル構造物の破壊解析)

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An ordinary state-based peridynamic (OSPD) shell model that consists of integro-differential equations without any spatial derivatives is introduced to deal with different kinds of fracture mechanics problems for shell structures in the present thesis. Meanwhile, a novel PD surface effect correction with arbitrary horizon domains is proposed to minimize the influence of the PD surface effect. Static and dynamic mechanical behaviors near crack surfaces are examined to demonstrate the effectiveness of the proposed surface effect correction. Furthermore, static and dynamic fracture parameters are respectively evaluated by employing domain form of J-integral and crack surface displacement extrapolation schemes to verify the fracture behaviors near the crack tip. Moreover, a novel stretch-based failure criterion for cracked shell structures is presented to simulate several dynamic crack propagation problems under in-plane and out-of-plane loadings. It indicates that the characteristics of dynamic crack propagation can be successfully captured in the proposed OSPD shell framework, such as crack extension path, crack propagation angle, complicated fracture patterns, etc. Finally, a series of dynamic fracture responses of monolithic glass plates subjected to blast loading is implemented. It reveals that the proposed OSPD shell model can simulate overall blast-loaded fracture patterns.