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Study of Fatigue with the Field Theory of Deformation and Fracture CONOR MCGIBBONEY, SANICHIRO YOSHIDA, NAOYA FUJISHIMA, SHUN TAKAHASHI, Integrated Science and Technology, Southeastern Louisiana University, TOMOHIRO SASAKI, Mechanical Engineering, Niigata University —
We are developing a physics-based numerical model for fatigue using the Field Theory of Deformation and Fracture. Typically, destructive testing is used to determine a specific material's fatigue properties. To examine this new theory for fatigue, we are comparing results from physical experiments with metal specimens undergoing fatigue loading against numerical simulations that describe deformation mechanics using wave dynamics. From our physical experiments we observe deformation wave dynamics, in metal specimens, using the optical interferometric technique Electronic Speckle-Pattern Interferometry (ESPI). With this approach we analyzed the temporal behavior of the displacement pattern formed while the specimen was experiencing cyclic loads. From the viewpoint of traditional Fatigue Analysis of aircraft wings, cracks are formed due to cyclic loading, and these cracks propagate through a structure. Failures occur when stresses on these cracks are above a material's ultimate strength. In our numerical simulations we qualitatively observe the same type of wave dynamics seen in our fatigue loading experiments. This work is of importance for aerospace engineers as it could be used to reduce costs associated with destructive testing.

Conor McGibboney
Integrated Science and Technology, Southeastern Louisiana University

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