Opportunities and Challenges in Peridynamics

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The peridynamic theory is an extension of traditional solid mechanics that treats discontinuous media, including the evolution of discontinuities such as fracture, on the same mathematical basis as classically smooth media. This talk will review the basics of the theory, emphasizing the similarities with the standard theory and points of departure. It will compare the initial goals and techniques in the theory, which is now in its fourteenth year, with the current state of development.

The growing community of peridynamics researchers can point to many achievements. This talk will give the author's perspectives on some areas where the theory can have further impact as it advances. It will also discuss some major challenges, including prospects for making the theory available to the engineering community as a general purpose analysis tool. The "mixed blessing" of nonlocality – which is a necessity that presents practical difficulties in many practical applications – will be discussed.

Among the likely growth areas is the theory's apparent potential as a mathematical tool for multiscale simulation. Since peridynamics is a strongly nonlocal theory, material models contain a length scale that characterizes the interaction distance between material points. This leads to the possibility of achieving a consistent multiscale modeling capability simply by varying the length scale in different parts of the region. Possible approaches and difficulties in achieving this will be discussed, including new work on a parameter-passing multiscale strategy based on peridynamics.