A THERMAL APPROACH FOR DAMAGE DETECTION IN COMPOSITES

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A new approach for damage detection in composites employing heat emission from cracked or broken optic fibers embedded in, or bonded to, composite plate structures was proposed and investigated. Optic fibers that were weakened by stripping of their jacket were embedded in, or attached to, a composite plate structure so that they cracked together with the structure when cracks or delaminations occurred in the composite. It is shown that at the location of a crack in a fiber transmitted light energy was converted into heat energy causing the temperature in the neighborhood of the crack to rise.The temperature change was detected by an infrared camera. An advantage of the proposed method is that it can exploit optic fibers which may already be embedded in a structure for other purposes, such as strain, temperature and frequency measurements. In other cases fibers can be glued to the rear surface of existing structures. When this method is used the sensors can also be easily replaced when damaged.

Experiments supplemented by theoretical studies were carried out. In the experiments an impact damaged graphite-epoxy plate showed that the heat energy emitted by fibers bonded to the composite plate was sufficient to raise the local temperature so that damage could be accurately located with an infrared camera. The extent of the damaged area which can be detected by this method depends on the density of embedded optic fibers, distance of the fibers from the surface, and the power of the laser used.