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Laser-ultrasonics is by now a well known and mature nondestructive technique for inspecting polymer matrix composites used in aerospace. This technique uses a pulse echo interrogation mode, in which ultrasound is first generated by a pulsed laser and then detected by a second laser coupled to an optical interferometer. The technique is particularly powerful for inspecting parts of complex shape. While very successful to find delaminations in laminates, difficulties are found for reliably detecting disbonds in honeycomb and foam core structures, particularly when the detachment occurs at the back skin. For this purpose, and other inspection tasks for which laser-ultrasonics usually fails (such as probing highly porous and attenuating materials like metallic foams), a novel technique called Laser-tapping or Laser-acoustics is proposed. Laser-tapping is based on the thermoelastic excitation by a pulsed laser of the top layer which bulges and is driven into vibration if it is detached from the material underneath. This bulging and vibration is then detected by a second laser coupled to a photorefractive interferometer. Laser-tapping uses essentially the same hardware as laser-ultrasonics but probes in a lower ultrasonic frequency range. Laser-ultrasonics and laser-tapping can then be advantageously used concurrently. In particular, since laser-tapping detects both skin delaminations and skin disbonds and cannot distinguish between them, the distinction can be provided by the time-of-flight between the laser ultrasonic echoes. The combined inspection system provides all the features of laser-ultrasonics, i.e. non contact, no surface preparation and ease of probing complex parts. The inspection system can also be made very flexible by using optical fiber coupling. Examples of applications of the combined system will be presented for a variety of honeycombs structures with defects, including delaminations in the skin and skin disbonds, at the front side and back side.

Keywords: Laser-ultrasonics, disbonds, coatings, honeycombs, porous materials

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