Carbon Nanotube Coated Paper Sensor for Damage Diagnosis Using Electrical Impedance Tomography

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Catastrophic structural failure causes significant physical and personal losses.[1] Thus, development of non-destructive real-time health monitoring of in-flight or fixed structure has been focused much these days. So far, a variety of discrete sensors such as strain gauges or piezoelectric transducers have been used for detecting regions of damages in real-time. However, these methods are prone to be complex inherently or heavy due to weight of discrete sensors and wiring requirements.[2]

Electrical impedance tomography (EIT) method has been introduced to overcome these disadvantages.[3] EIT uses the material as a sensor without any discrete sensor to diagnose damages on the material surface. By applying a small electrical current to the material, electrical potential changes at various locations are measured. The damaged spatial location and its magnitude are predicted by solving the inverse problem, which is calculating the conductivity distribution from the known injected current and the measured voltages.

In this presentation, carbon nanotube coated paper (CNCP) is used as a sensor material to identify spatial structural damages. The CNCP has several advantages over other materials such as easy fabrication, flexibility, and operability under extremely low temperatures. This highly conductive paper has been made from aqueous carbon nanotube ink using sodium dodecylbenzenesulfonate as a surfactant.[4] Boundary potentials are collected by a circular 16-electrode array around the CNCP. Then, resistivity images are reconstructed from the boundary data using EIDORS (electrical impedance and diffuse optical tomography reconstruction software).[5] Reconstructed images are evaluated with the EIDORS simulation results. Finally, the minimum detectability by damaged spatial location and its magnitude will be addressed.

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