Details of Research: Multi-layered composite armor plates are currently used in prototype armored vehicles. In order to ensure their integrity, and thus the safety of the personnel inside the vehicle in the event of combat, these plates need to be inspected nondestructively from the outside. Due to its complexity and anisotropy, this type of armor plate is very difficult to inspect and conventional nondestructive inspection methods have severe limitations when applied to it. Thus, more advanced techniques are being developed.

In Phase I of this SBIR project, we demonstrated the feasibility of using acousto-ultrasonics to detect defects in hybrid-composite armor plates. During Phase II, images of seeded circular delaminations of varying diameter located at different depths in sample composite plates have been produced. The acousto-ultrasonic technique uses acoustic emission transducers and an arbitrary waveform generator operating in an ultrasonic testing mode and interfaced with a precise scanning bridge. A wave propagation model for multilayered media has been used to predict the response of the armored plate in the frequency domain. With this information, inspection parameters such as incidence angle and frequency of the ultrasonic wave have been optimized for detection of defects at different depths.

Other Thoughts: This system can be easily modified to be used in other applications involving other kinds of composites in industry.