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FEATURE

A Glimpse at Technology's First Draft —*by Patrick Hartary*

Small technology companies try to invent their way into missile defense systems while thinking of future commercial prospects.

Innovate! That's MDA's prime directive to small technology companies undertaking early-stage research in its SBIR program.

To innovate, these companies must test the scientific and technical merit of a particular concept—for example, a faster way to acquire and track an enemy missile. Interestingly, this concept might also prove marketable in other "nonmilitary" uses, such as detecting breast cancer, inspecting gas pipes for leaks, or evaluating semiconductor bonds without destroying them.

Since its inception, the MDA SBIR program has awarded thousands of Phase I contracts for early-stage research. Below is a sampling of the newest projects undertaken. In each project, the small technology company proved their theory and not only produced a technology potentially valuable to MDA, but also to industry. Note that all three MDA-funded technologies are in various stages of development.

Nitride and Carbide Composite Zones in Metals

JET Technologies, Inc. (Locust Grove, VA), has developed a method of forming gradient nitride and carbide composite layers in metals, most notably titanium and aluminum. This method is different from other processes that simply convert a thin layer at the surface or apply a coating. For example, JET's process can be used to create a gradient titanium nitride composite up to 0.250-inches thick in titanium objects and a gradient aluminum nitride composite up to 0.05-inches thick in aluminum objects.

JET's innovation involves melting a given depth of metal using a proprietary plasma process and infusing it with the proper amount of reactants to create the desired composite layer. Others can perform a similar process, whereby they melt the surface and embed ceramic particles or fibers in the melt. According to JET, their manufacturing process is 3- to 20-times less expensive than these competing methods, when the cost of the initial facility, extra materials, and the cost of labor are considered.

The challenge for JET Technologies is to identify military and commercial applications for its technology. The JET Process offers the potential to decrease the overall weight, increase the strength, and increase the wear resistance of critical MDA components. Similar applications exist for industry. For example, wear-resistant components for manufacturing can be made without requiring fibers or particles. One drawback is that the process leaves a slightly rough surface. If required, this surface can be polished.

In a recent demonstration, the JET process created titanium nitride wear surfaces on titanium center guides for U.S. Army tanks. Follow-up surface modification was not required because the as-processed surface of the guides did not adversely affect their performance. The Army concluded from the results of wear tests that samples offered 2- to 3-times greater wear resistance yet were 45-percent lighter than the standard high-hardness steel used today.

JET Technologies is planning to investigate the formation of nitride composites in zirconium and halfnium and carbide composites in vanadium, niobium, and tantalum. The company is looking for development partners with identified applications.

Machining of Ceramic Materials

Third Wave Systems, Inc. (Minneapolis, MN), is designing a software package to model ceramics machining processes. This tool can be used to identify optimum process conditions for machining ceramics; that is, those that result in reduced machining time and increased yield. The software can be seen as a sophisticated replacement for a machine tool operator's experience or a manufacturing engineer's "book knowledge."

The tool is based on Third Wave System's existing software package, called AdvantEdge™, which can be

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Tough stuff. *JET Technologies' process grew one-eighth of an inch of titanium nitride inside a U.S. Army tank center guide made of a titanium alloy. Tests showed a significant increase in wear resistance.*

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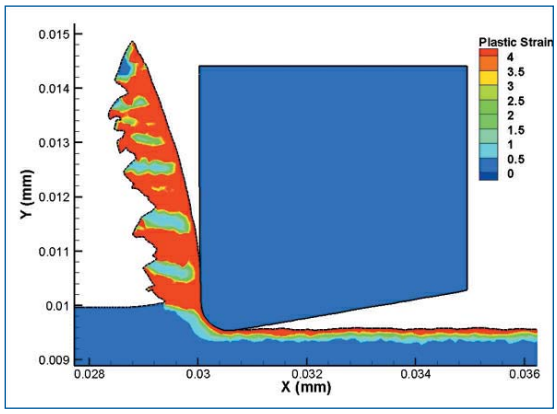
used to model metal machining processes, such as turning and milling. AdvantEdge provides users with very detailed information on the amount of heat being generated, heat flow, and the characteristics of the machined work piece surface. It can help expose any potential flaws or residual stresses that can adversely affect the quality and performance of machined parts. Notable AdvantEdge customers include Boeing, General Motors, Caterpillar, Ford, and Northrup Grumman.

Third Wave Systems is building on research conducted by John Patten, a professor at the University of North Carolina-Charlotte, who found that brittle silicon germanium materials can be machined using certain cutting-tool geometries and process parameters. Through its MDA SBIR Phase I contract, the company validated Patten's discoveries using silicon nitride.

This innovation will lead to potentially many new applications of ceramic components for automotive, aerospace and machine parts. Industry will benefit economically through significantly reduced testing trials, improved productivity, lower component costs, increased component quality, and expanded manufacturing capability. MDA is interested because the software could substantially reduce the amount of prototyping time needed to create MDA components, such as lenses, mirrors, windows, and radar domes.

Third Wave Systems seeks customers with specific applications or companies interested in forming alliances.



First cut. *Industry currently lacks the knowledge and ability to model ceramics machining processes. Third Wave Systems is developing prototype software that will allow customers to study, through simulation and process modeling, the manufacturing conditions inherent to the machining of ceramic materials.*

Monitoring Internal Attacks on Computer Systems

Xfinit, Ltd. (Florence, MA), has developed an algorithm that monitors and detects internal attacks on computer systems. The algorithm monitors the actions of a particular computer user and alerts someone—most likely a security officer—in the event of unusual activity by that user. It operates inside a firewall and can address inside security issues by identifying people who are "fine" one day and "suspicious" the next.

The algorithm works by establishing a baseline for each individual by monitoring that person's activities in an application for a given time period. After the baseline is established, an acceptable variance is entered into the system so that the algorithm can detect when activities fall outside the normal range and alert someone to this fact.

For example, a security officer can easily set up a "sensor" that monitors the frequency of access to an electronic repository of secure documents. The sensor can be configured so that if the frequency of internal access fluctuates no more than 50 percent in a day, no alerts are triggered. However, if the frequency of internal access rises above 50 percent, the sensor will set off an alarm and notify the security officer.

With the technology's multiple sensor capability, information residing on application servers across multiple applications can be grabbed and analyzed, which leads to significant reductions in false alarms—or what industry calls "false positives." An employee may have a valid reason to exceed the 50 percent threshold for accessing the electronic depository, as described above. But the security officer can set up additional sensors, say to monitor travel requests and long distance calls, that provide more data for analysis. Consider this scenario: If multiple sensors detect a person exceeding the thresholds for electronic depository access, foreign travel requests, and telephone calls to a particular foreign country, this person might warrant further investigation.

The algorithm has enormous potential as its commercial and military applications are many. For example, Xfinit says that credit card companies, some of which employ hundreds of people to track down false positives, could significantly increase their fraud detection efforts while decreasing labor costs. These companies are using neural network-based security products, which are limited to monitoring one application at a time.

Having completed its MDA SBIR research, Xfinit is actively looking for development partners with potential security applications for this technology.

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