Detecting Defects Through Vibration

Breakthrough technology of Advanced Vector Analytics promises safety, reliability, savings

BY BETH E. STANTON

WHEN MAN-MADE OBJECTS such as airplanes, cars, bridges, or buildings lose structural integrity, the results can be devastating. Observing vibration as it moves through materials using sensors is a standard method for detecting faults. Traditional vibration detection uses a one-dimensional approach to measurement. These sensors increase in number with complexity, with some turbine engines containing 3,000-20,000 sensors. Advanced Vector Analytics (AVA), a Latvia-based startup, has developed the next generation of system health monitoring, called structural immunity monitoring (SIM). SIM uses stress-sensitive sensors that monitor strength the way the human nervous system monitors information via neurons.

AVA has developed a system that uses sensors in a radically innovative way: using four dimensions. The two pillars of the system are 4-D vibration sensing and holospectrum analysis. The 4-D approach combines measuring vibration in the x-, y-, and z-axes and tracking vibration over time, the fourth dimension. Compared with other methods, this system generates a far greater amount of information by considering the phase of signal between the measuring axes. Measuring and analyzing these complex vibration patterns determines precisely how they arise, as well as the source and cause of any pattern change. Early detection can prevent progression of the defect.

The mission of AVA is to improve the safety of critical mechanical systems in both aerospace and ground-based applications. Engineers in all industries can apply this technology. From materials, design, and production to maintenance, the life cycle of mechanical systems may be revolutionized. This technology is designed to help aerospace engineers transition from time-based maintenance to more efficient condition-based maintenance. The cost savings associated with this transition are dramatic, saving up to 80 percent of maintenance costs by eliminating unnecessary maintenance done on components that are still in good condition. This system needs far fewer sensors than other solutions. It is so efficient, only two of AVA's 4-D sensors are used instead of 168 regular sensors in jet engine flutter analysis. The striking savings of weight and cost make this technology affordable for both new aircraft and retrofit. It can be applied for all critical elements of aircraft, such as propeller, gearbox, engine, airframe, and wing.

Besides huge savings on maintenance, research, and development, there are other compelling benefits for adopting this technology. Number one is increased safety. Real-time monitoring in flight supplies information to the operator about the stress in structures and predicts defects before they appear. By understanding materials and structures better, this technology has the potential to usher in a new era of more intelligent design. New materials can be tested and monitored to lighten air transport and reduce fuel consumption. More efficient structures won't require excess margins of strength and will use fewer resources. This could lead to innovative designs not only of aircraft, but also of buildings, cars, and other mechanical objects.

Advanced Vector Analytics' ambition to revolutionize aerospace is gaining traction. AVA is affiliated with the AeroInnovate business accelerator program at the University of Wisconsin and participated at EAA AirVenture Oshkosh 2015. In October, it pitched at the global technology competition Hello Tomorrow in Paris and was a top three finalist out of 3,000 startups. In November, it received an invitation from Starburst Accelerator, the first startup accelerator dedicated to aerospace, aviation, and defense. AVA's technology has been granted five patents. The successful software beta tests done at the Elektrenai Power Plant in Lithuania were proof of the capability of this technology, a crucial landmark for its development plan and financial investors. More than $3 million has been invested in the form of grants and pre-seed venture capital. The company has reached its current situation backed by Russian scientific funds, the global energy company Gazprom, the Latvia-based business incubator Cesis, the Latvian government, and Imprimatur Capital's Riga branch. AVA already has one implementation by the Central Institute of Aviation Motor Development (CIAM) and is very close to another in the helicopter segment.

Edgar Grant, AVA's co-founder and CEO is optimistic about the future. "This is the next generation of measurement systems," he said. "It is inevitable that mechanical systems are going to become more intelligent. This is exactly what we are doing, and we are excited about it. We understand that this process takes time and we are patient. We are happy to introduce this technology to the world." EAA

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