Avitas Systems
a GE venture

Robotic integration

An Overview of Avitas Systems's
Robotic Capabilities
November 2018

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Avitas Systems, a GE venture, provides state-of-the-art air, surface, and subsea robotic-based autonomous and semi-autonomous inspection solutions using predictive analytics, workflow management, and safety compliance.

Today's manual inspection methods can be unsafe, as they often require workers to enter confined spaces or use ladders, scaffolding, cherry pickers, or ropes and harnesses. Assets are also typically shut down during inspection, causing operators to lose revenue.

Avitas Systems, a GE venture, provides state-of-the-art air, surface, and subsea robotic-based autonomous and semi-autonomous inspection solutions using predictive analytics, workflow management, and safety compliance. The Avitas Systems cloud-based platform uploads inspection data from robotics in real time and fuses the data with regulatory, external, and historic data sources. The risk-based insights outputted are accessible online via the Avitas Systems Platform. Avitas Systems solutions help protect assets by detecting defects and reducing downtime and risk.

Avitas Systems partners with a range of robotics manufacturers and then customizes them with sensor kits for the following solutions:

> 3D modeling using photogrammetry and LiDAR
> Asset inspection
> Corrosion under insulation
> Fugitive gas detection

AERIAL ROBOTICS

Avitas Systems uses autonomous inspection systems that integrate aerial robotics, sensor technology, including LiDAR, and cameras such as RGB and infrared (IR). These integrated systems uniquely enable safe and disciplined autonomous flight operations, ultimately leading to precise and targeted inspections. Avitas Systems autonomously converts digital 3D models of industrial assets into precise flight paths for aircrafts to follow.

Rotary-wing and fixed-wing aircrafts

Avitas Systems uses two types of inspection aircrafts: rotorcrafts and fixed-wing aircrafts. Rotorcrafts are mainly used for autonomous aerial inspection of vertical assets, such as flare stacks, and fixed-wing aircrafts inspect horizontal assets, such as pipelines and well pads. The sensors Avitas Systems customizes can attach to both rotorcrafts and fixed-wing aircrafts. Avitas Systems strategically collaborates with various drone providers and independently integrates end-to-end inspection systems, ground control stations (GCS), and payloads with drones. Rotary-wing aircrafts are most useful when there is no

runway space to launch, which fixed-wing aircrafts need, or when navigating tight spaces that require vertical takeoff and lift (VTOL). Rotary-wing aircrafts are also more efficient when planning flight orbital patterns for photogrammetry, 3D modeling, fugitive methane emission (FME) inspection of an area for an overview analysis, and simply the ability to hover in place.

Rotary-wing aircrafts can fly up to forty-five minutes, particularly for FME applications. A rotary-wing aircraft powered by gas instead of battery can fly for approximately four hours. Fixed-wing aircrafts' flight time depends on their size, power source, and payload weight. Some fixed-wing aircrafts can fly for approximately thirty minutes, especially with a light camera and payload.

SURFACE ROBOTICS

Avitas Systems also uses ground-based crawlers with integrated control systems and swappable sensors, which climb or latch onto assets to capture images of defects, such as weld cracking, or perform ultrasonic thickness testing.

Snake inspection robot

The snake inspection robot is a multi-purpose, portable robotic crawler. The robot has a tether-less system, which is operated remotely, with a built-in battery source and wireless communications. The robot's travel range is up to 300 feet line-of-sight but can be expanded up to 1,500 feet with an optional radio module. The crawler can be operated in different configurations best suited for the inspection application, including RGB cameras to provide 360-degree views around the crawler. Ultrasonic (UT) sensors can also be attached to the front of the crawler, using a dry couplant wheel transducer to measure surface thickness.

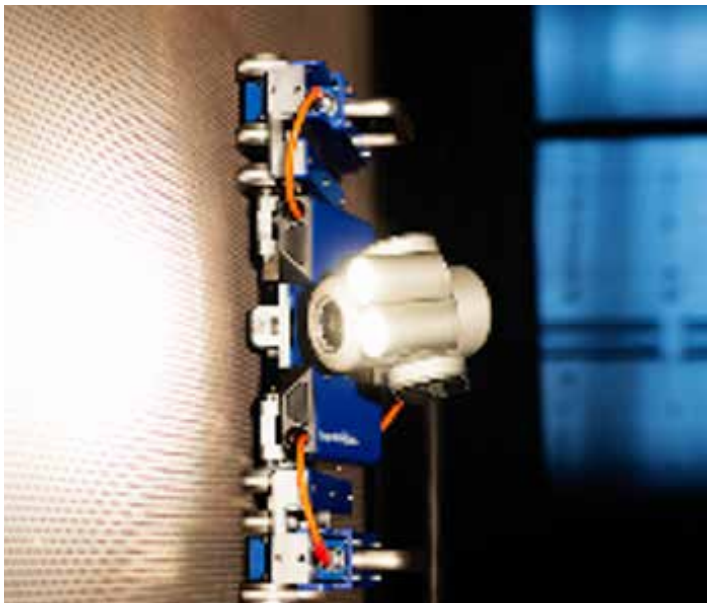
With an array of cameras for a 360 view, the crawler has LED lights to see in low-light situations and an IR camera for thermo-imaging for viewing hotspots. Avitas Systems often uses the snake robot because it can climb ferrous vertical structures, such as storage tanks and walls, using permanent magnets. With treads on its tracks, the crawler can also traverse grass, sand, mud, and other liquid or rugged terrain. The crawler has a 5-DOF mid-body section, which allows it to lift the front track to overcome obstacles and climb stairs. The small size of the track bodies allows the crawler to travel through small openings, such as enclosures and pipes.

BIKE

The BIKE inspection robot is small and versatile for tighter, more confined environments. RGB cameras and UT sensor attachments allow the robot to closely inspect corrosion areas and take thickness measurements in small spaces. In addition, the robot can use its borescope attachment with a RGB camera to observe hard-to-reach locations. Avitas Systems often uses the BIKE crawler because it's uniquely mobile. BIKE robots can traverse flanges and make 90-degree transitions from vessels to pipes.

BIKE robots can also autonomously scan vessels, using Simultaneous Localization and Mapping (SLAM), which is advanced technology that allows the robots to simultaneously map a site while also tracking its location. To safely navigate toward inspection points of interest, the BIKE crawler is equipped with several navigation aids. Internal IMUs (Inertia Measurement Unit) constantly sense the position of the robot in a three-dimensional space. Additionally, internal encoders deliver information about wheel rotation. Avitas Systems uses control software to load 3D CAD models of industrial assets for targeted inspections.

A BIKE robot can inspect small spaces, such as nozzles and elbow connections, and retrieve closer observations of welds, joints, and corrosion spots. Its magnetic wheels can be installed for maneuvering on ferrous surfaces, such as storage tanks, external and internal piping, and other obstacles. BIKE can both inspect on vertical surfaces and travel on the underside of assets.



FAST RVI robotic variation

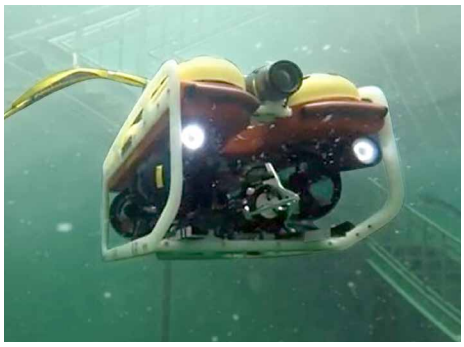
BIKE robot

TRIC

The Three Wheel Inspection Crawler (TRIC) has high maneuverability, adaptability to many different inspection tasks, and the ability to be equipped with RGB cameras for inspection. The TRIC has three independently driven wheels, allowing it to maneuver in all directions and actively steer or tilt to navigate curved surfaces. The wheels are magnetic to allow operation on vertical surfaces. A center port is available for optional sensor modules, such as ultrasonic, eddy current, and additional cameras. The TRIC operates on battery power sources and is completely tether-less, with wireless transmission for data transfer and system control to base stations.

FAST

The FAST robot has different variations, including FAST RVI, FAST UT, and FAST CR. Each variation is based the same base module. The base module can travel on flat or curved surfaces, such as pipes. The FAST RVI mounts a high-res PTZ RGB camera with LED lights for low-light inspections. The FAST-UT has a UT module for corrosion mapping and weld inspections. The FAST CR performs a variety of surface maintenance functions, including cleaning, grinding, polishing, and painting surfaces with adaptable tool modules. The FAST robots can access tight spaces and are portable for easy deployment. Their magnetic wheels allow for vertical and upside-down travel on ferrous surfaces. They can be used to inspect the exterior and interior of assets, such as tanks and vessels, or wherever work is needed within confined spaces without having to alter structures or equipment.



Kraken autonomous underwater vehicle

SUBSEA ROBOTICS

Avitas Systems integrates autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs) with acoustic and laser sensor technology and artificial intelligence-based navigation software into unique subsea inspection solutions. These solutions can be tailored to underwater production fields, as well as subsea pipelines and cables. Advanced sensors attached to AUVs and ROVs combine laser scanning and camera imaging to provide detailed data on defects, such as corrosion, cracks, and marine growth. The scanning process can be repeated, generating coordinate values for inspection points that become highly accurate 3D models of subsea infrastructure.

AUVs and ROVs

Avitas Systems uses versatile AUVs and ROVs to complete a wide variety of inspection tasks. ROV pilots use hand controllers to manage the robots' movements and send commands via an electrical umbilical. The pilots can also control the vehicles' video systems, lighting, and other associated equipment. The systems' software can be configured to suit pilot and customer requirements. AUVs are programmable versions of ROVs, relying on a map of their environment. AUVs only require pilots simply to monitor safety. AUVs and ROVs can move in any direction, and by using autopilot functions, they can consistently navigate on course. AUVs and ROVs inspect subsea trees, manifolds, wellheads, pipelines, and connectors. AUVs and ROVs both come with or without tethered capability – tethering is generally required for longer operations with many power requirements and data feedback.

Avitas Systems field team setting up a DJI M600 before flight

Visit Avitas Systems at: ***www.avitas-systems.com*** *or* ***@Avitas_Systems*** *on Twitter.*

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