



BIKE platform

Ultra mobile inspection robot



BIKE platform

One of the main advantages of mobile robots is their ability to reach locations inaccessible by human because of size constraints, temperature, immersion in liquids or safety reasons. Certified and experienced engineers today enter confined spaces and “look” at the predefined locations to take pictures for reporting. This is the state of the art procedure. Beside very expensive organizational issues such as watchmen and ventilation, this procedure is very dangerous for the experts. New robotic and sensor technology can provide solutions to reduce costs and risk of such procedures.

In this framework, the BIKE inspection robot has been developed. The BIKE platform is a magnetic wheeled robot capable of inspecting power plant facilities and multiple applications in the oil and gas industry, such as vessel or pipe inspection.

The innovative locomotion concept allows climbing obstacles such as stairs and 90 degree corners (convex and concave). With integrated navigation cameras and 3-dimensional position sensors the operator gets precise information about the robots position even in complex environments. Multiple additional modules, such as Ultrasonic probes or borescope holders are available to extend the function of the robot and open new ways for inspection without human entry in confined space.

Ultramobile robotic platform

With the BIKE platform Waygate Technologies Inspection Robotics has realized a truly ultra-mobile inspection platform. Where existing inspection crawlers are reaching their limits in terms of accessibility and maneuverability the BIKE platform is just beginning to perform.

In the power generation market the platform is used for the inspection of gas turbines or hydro power stations by carrying videoscope probes. Other applications are visual inspection of pipes, exhausts, pressure tanks or heat exchangers.

In the oil and gas market the main tasks are visual pressure vessel and pipe inspections. By installing the Ultrasonic probe module the platform turns into a proper thickness measurement gauge which can even perform line scans.

At a glance

- The BIKE platform is a lightweight (10kg) ultra-mobile robotic platform.
- Can be deployed through a 10" manway
- Capable of passing convex and concave corners of up to 90 degrees (steps, obstacles, flanges, ...).
- Fully remote controlled and equipped with navigation aids (front and rear view cameras and 3D pose view).
- Payload of 10kg, can be equipped with NDT sensors (Ultrasonic / Phased Array, Eddy Current) and/or Pan-Tilt inspection camera

Robotic evolution

The development of the BIKE platform was kicked off at the Swiss Federal Institute of Technology (ETH Zurich) as an industry research project. Inspection Robotics took over the patented locomotive design and developed it further for field service applications. During this industrialization phase the concept changed from a the original two wheeled BIKE platform with small lifter wheels to an AWD four wheeled

robot. This gives the platform more stability and payload to cover additional applications in the power generation and oil and gas industry. The development process to the system today took 10 years. Furthermore, multiple patents could be filed and are used in other Inspection Robotics systems.



Passing obstacles

One engineering masterpiece of the BIKE platform is its ability to overcome obstacles and maneuver in complex environments. The four-wheeled robot can pass 90 degree inner and outer corners. In industrial environments this means transitions from horizontal to vertical pipes and even movement upside-down is possible. Practical examples are interconnected pipes like t-joints or flanged connections. Furthermore this technology enables to drive directly into confined spaces from an accessible man-way.



Integrated Control Station – ICS 2

To operate a robotic inspection system in an industrial environment it is crucial to have a reliable control station. With the second generation of Integrated Control Station – ICS 2 – the operator has the all-in-one tool at his hand. It comes in a rugged hardshell case (Pelican®). All embedded components, as the 21.5" touchscreen, high performance PC or Joystick are selected according to industrial standards. This means extreme robustness and reliability in harsh environments as well as guaranteed spare parts for 10 years.

Simplicity and ease of operation was key when developing the ICS 2. The operator needs to plug one single cable to connect the BIKE platform. Operation by use of the integrated joystick is simple and self explaining.

Spec check

- 48V Control Station (max. 640W)
- Integrated industrial computer (Intel i7-6600U, 8GB RAM, 128GB mSATA)
- Microsoft Windows 10 OS
- Integrated 21.5" touchscreen monitor (Full HD, 1200cd/sqm Ultra High Brightness, Rugged industrial, glove friendly)
- I/O: GBit Ethernet, 2xUSB 2, 2xUSB 3.0, Encoder Out
- Integrated rugged navigation joystick
- Industrial emergency stop system
- Pelican® fan-less, IP67 (closed) on rollers
- Weight: 21kg (46lbs)
- Power Supply: 100-240 VAC



Control software

3D View

Navigation and path tracking in 3D. Assets can be loaded or generated in the software. Supported file formats *.obj and *.stl

Information

Speed, distance, status and drive modes

LED light adjustment

Individual control of LED lights (left, right and bottom lights)

Front View Camera

BIKE integrated front camera for remote navigation. Options to record pictures or videos.

Rear View Camera

Add-on for close-up inspection – borescope

For surface inspection and measurements, a video borescope probe can be mounted. Modern borescope devices such as Waygate Technologies Mentor Visual IQ allow for high quality inspection and precise 3D measurements.

The deployment mechanism allows for positioning the probe head right to the location of interest. This enables the operator to access nozzles, joints, welds or elbow connections. And because the robot is holding the probe there is no shaking and blurry images. Furthermore, the 3D phase measurement technology delivers exact measurements and accurate 3D views.

At a glance

- Borescope holder can be attached either on the side or on top of the BIKE
- Borescope probe length available up to 30m
- Accurate measurement of pitting and corrosion



The Mentor Visual IQ

Advances in image based 3D measurement are making the video borescope an increasingly powerful tool in the inspector's toolbox. While in the past, inspectors could identify indications and capture images; today's advanced video borescopes allow them to map, measure, and analyze indications in 3D and to share images and data wireless with remote experts. With enhanced precision and accuracy, this new functionality is allowing video inspection to complement, or in some cases, replace other NDT modalities.

Using patented structured-light technology, 3D Phase Measurement enables inspectors to locate, measure and analyze an indication using the same tip optic. The wide field of view and large depth of field allow for measuring with the same tips used for inspecting, thus eliminating the extra steps required to back out, change the tip and then relocate the indication.

In effect, 3D Phase Measurement provides accurate measurement "on-demand" while saving time and increasing overall inspection productivity. 3D Phase Measurement employs structured light patterns projected from the tip to create a 3D surface scan of the viewing area and can measure all aspects of surface indications.

Spec check

- Easy to operate using either optically bonded multipoint touchscreen and on-screen keyboard, or ergonomic joystick and hard keys

- Capture crystal clear live video and still images with Adaptive Noise Reduction (ANR) and High Dynamic Range (HDR) still image capture
- Advanced analysis using 3D Phase Measurement (6.1 mm probe) and 3D Stereo Measurement
- Portable, lightweight, ergonomic design (3.0kg / 6.75 lbs out of case)
- Rugged durability – designed to IP65, MIL STD 461F and MIL STD 810G standards
- 16GB internal SSD for user data storage
- High intensity LED light source and advanced processing for improved image brightness
- Interchangeable high resolution 4.0 mm, 6.1 mm and 8.4 mm diameter probes available in multiple lengths to suit a variety of industries and application



Add.On – Ultrasonic module

An Ultrasonic probe holder module can be mounted in between the front wheels for accurate thickness measurement. The module is actuated remotely by a couplant pump that lowers the Ultrasonic Transducer onto the surface. Additionally, the water is routed to the probe head and acts as couplant for the ultrasonic transmission.

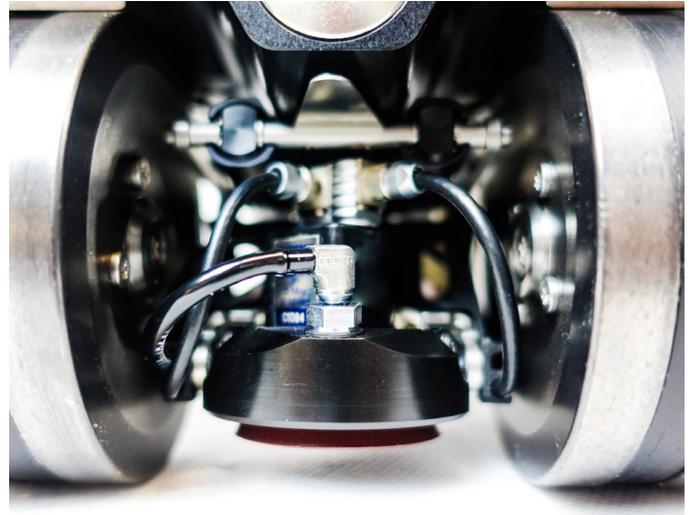
The standard transducer is a dual element pitch-catch probe. It creates a V-shaped sound path in the test material where one element acts as sender and the second as receiver. This improves near surface resolution and is therefore ideal for remaining wall thickness measurements. Also on curved or rough surfaces this technique delivers good results.

The advantage of the modular design is that any available thickness measurement can be used. An operator does not need additional training nor does an existing procedure have to be updated.

The UT module gives an inspector the ability to perform a thickness measurement in remote location using his existing procedure and equipment. To put it simple: It becomes an arm extension for inspectors performing UT measurements.

Spec check

- 10mm zero degree dual element
- Available in 5 Mhz or 10Mhz
- Lemo 00 Connector



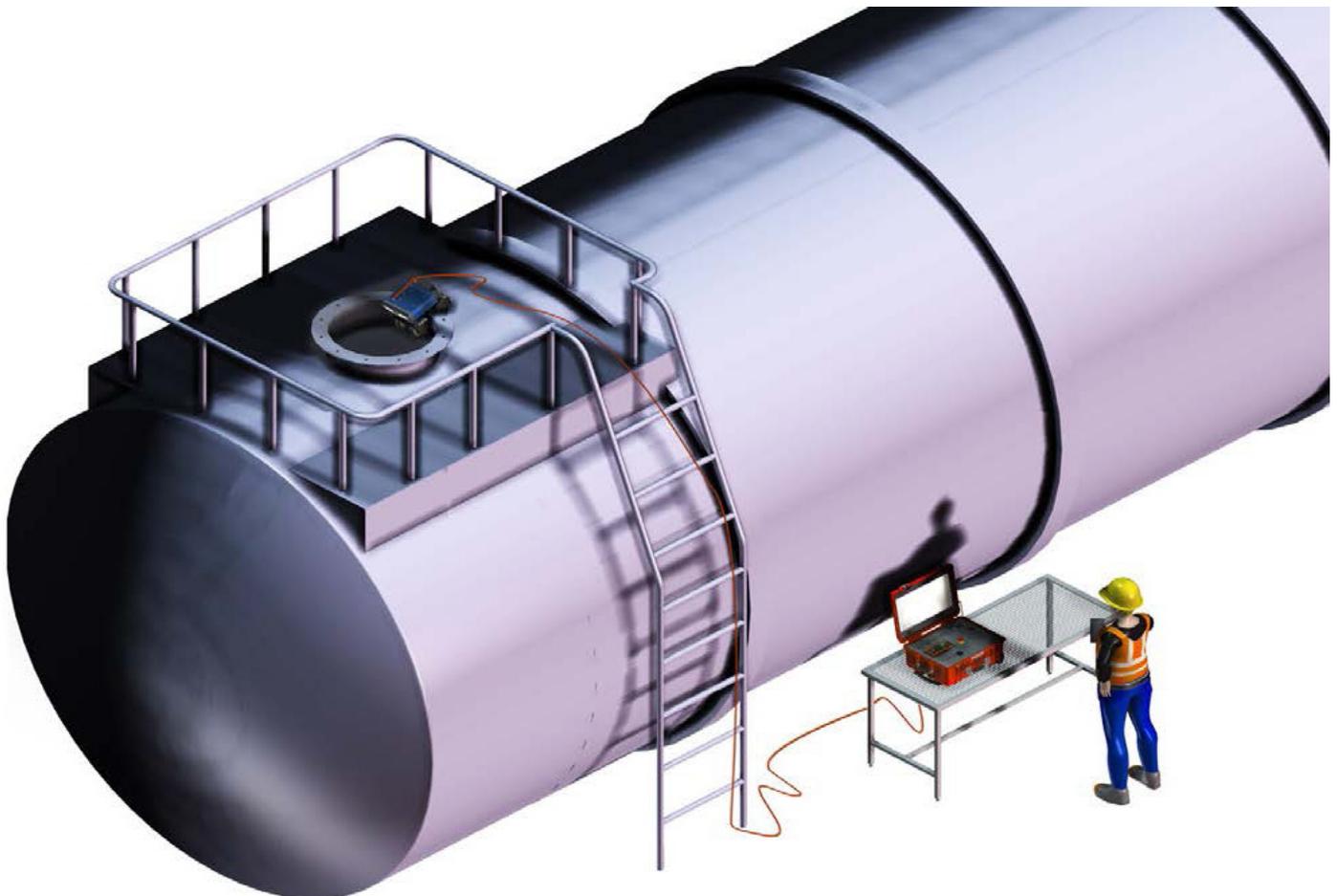
Remote navigation

To safely navigate to the points of interest the BIKE is equipped with several navigation aids. Internal IMUs (Inertia Measurement Unit) constantly sense the pose of the robot in the 3-dimensional space. Furthermore, internal encoders deliver information about wheel rotation. All sensor data is processed by the control software and displayed live in a 3D model. To give the operator an even more precise indication of his position and path the control software allows to load 3D CAD models of the inspected asset. This leads to a great user experience and confidence in the inspection.

Setup and deployment

With its unique obstacle climbing capabilities the BIKE is very easy to deploy for confined space inspection. Several methods can be applied. The easiest and most practical way is to simply place the robot onto an accessible location on the man-way. The platform can pass the 90 degree transitions and enter the asset. All 4 wheels are driven individually and have built-in strong magnets for maximum torque and stability.

The operator controls the system from the Integrated Control Station (ICS 2) which will be positioned at a safe location. Standard cable lengths is 30m (10m for Ultrasonic some practice and is therefore part of the standard training provided with the system. inspection) and can be extended up to 75m. Deployment and navigation in remote environments needs



Part list and options

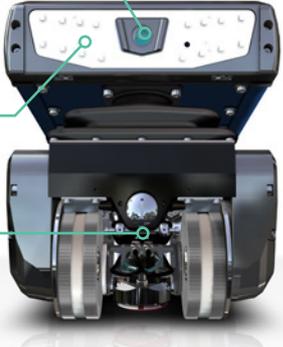
To navigate the BIKE platform in remote environments it is equipped with miniature cameras in the front and back of the platform. High resolution miniature SuperFisheye™ Lenses provide a field of view (FOV) of greater than 180 degrees.

The cameras are embedded in the specially designed LED light boards. Lights are individually adjustable left and right to enable shadowing techniques for professional inspections. This, combined with the hybrid glass – plastic design of the lense makes it ideal for low-light applications.

Front View Camera
High resolution miniature SuperFisheye Lenses provide a field of view (FOV) of greater than 180 degrees.

Power LED bar
16 LED lights with >2000lm left and right adjustable

Ultrasonic Module
Remote actuated twin crystal ultrasonic probe for wall thickness measurement



Rear View Camera
High resolution miniature camera and 8 LED lights (>1000lm)

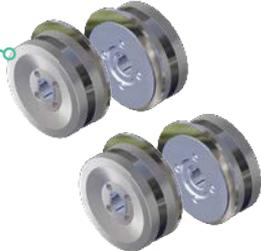
Connection Module
48V and 100Mbit Ethernet to extend functionality (cameras, Inspection Device,...)

Ultrasonic Connection
2 Lemo 00 and water supply are connected to the rear of the robot



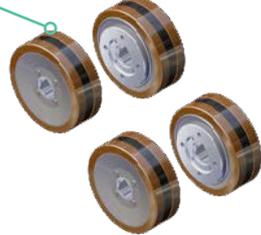
Wheel Options

Standard
Knurled wheels for maximum traction and magnetic force



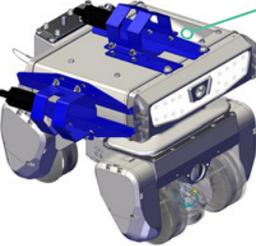
Coated
Polyurethane coated wheels for delicate surfaces

Note: magnetic adhesion reduced by 60%

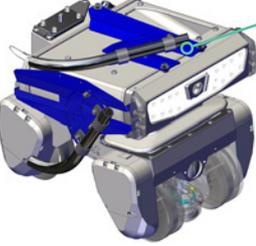


Visual Inspection

Camera holder
Adjustable holder for inspection cameras, can be mounted on top or side



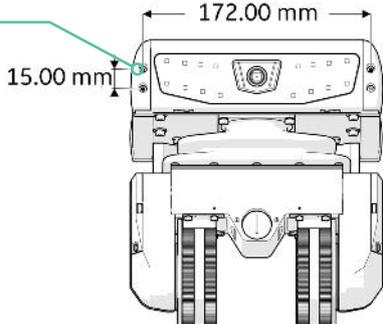
Borescope holder
Adjustable holder for borescopes probes up to 9.6 m (0.38") diameter. Angle and position fully adjustable.



Bring your own device

Front mounting
Four mounting points available on front face of the BIKE. Can be used to mount additional cameras, borescope probes, laser guides or simply bumpers (included)

Screws: **4x M3 / 6mm**
Weight: **max 1kg**

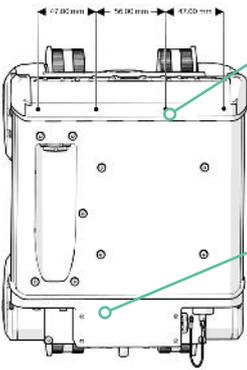


Top front mounting
Four mounting points available on top front of the BIKE.

Screws: **4x M4 / 6.5mm**
Weight: **max 2kg**

Additional top mounting
Contact technical support for weight distribution and center of gravity.

Weight: **up to 10kg**



Dimensions and capabilities

Inside pipe
Minimum inner pipe diameter for straight line driving
300mm (11.8")



Ø300.00 mm

Inside pipe
Transition from longitudinal to circumferential by spot turn
400mm (15.7")
Full maneuverability inside pipe with minimum diameter
600mm (22.6")



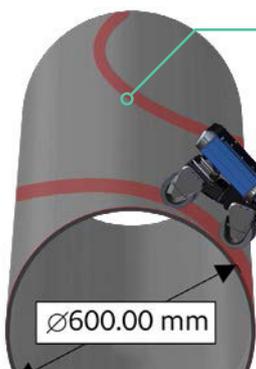
Ø400.00 mm

Outside pipe
Minimum pipe outer diameter for straight line driving
400mm (15.7")



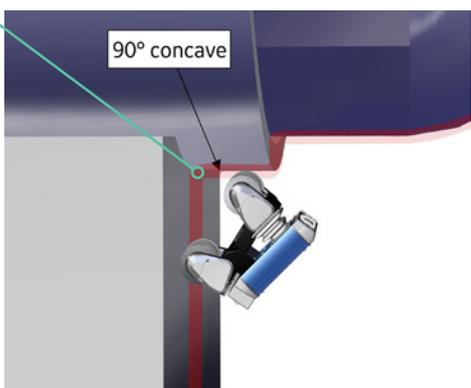
Ø400.00 mm

Outside pipe
Full maneuverability on pipe outside diameter minimum
600mm (22.6")



Ø600.00 mm

Concave corners
Ability to climb inner steps and corners up to **90°**



90° concave

Convex corners
Ability to climb outer steps and corners up to **90°**
Enables the platform to enter man-ways from the flange



90° convex

Technical specification

BIKE Basic platform (borescope / probe module not mounted)		
Dimensions	Length	247mm (9.72")
	Width	190mm (7.48")
	Height	217mm (8.54")
Weight	w/o cables and water hoses	9.6kg (21.2lb)
Speed	Fully adjustable	-50mm/s ... 50mm/s (-2"/s ... 2"/s)
Payload	On clean ferromagnetic surfaces	10kg (22lb)
	Overhead	5kg (11lb)
Drives	4 integrated drive units with 48V brushless DC motors (Maxon)	
Power supply	48V via umbilical cable from Integrated Control Station	
Motor controller	Integrated Inspection Robotics motor controller	
Communication	Gigabit Ethernet with power over Ethernet	
Cable length	ICS2 to robot standard version	30m (100ft) (longer on request)
	ICS2 to robot (with UT module, incl. couplant)	10m (33ft) (longer on request)

ICS 2 Integrated Control Station		
Dimensions	Length	560mm (22.01")
	Width	455mm (17.93")
	Height	265mm (10.43")
Weight	Incl. cables and joystick	21kg (46lb)
Protection class	Box closed	IP67
Power	100V ... 240V AC	640W
Computer	Intel i7-6600U, 8GB RAM, 128GB mSATA, rugged industrial, Windows 10	
Screen	21.5" touchscreen, Full HD, 1200cd/sqm Ultra High Brightness, rugged industrial, glove friendly	
I/O	1Gbit Ethernet port, 2xUSB 2, 2xUSB 3.0, Encoder Out	

Development support

No matter if you want to use your existing Inspection cameras or go for a new fully integrated inspection system. The BIKE platform is the perfect carrier platform for hard to reach areas. This gives you the opportunity to continue

to use existing inspection devices and provides a crucial advantage for future inspections. Our engineering and development team will support you to adapt and tailor the system for the application you need.

