Robots

Medical Robots

Robotics holistically + InnotecUK

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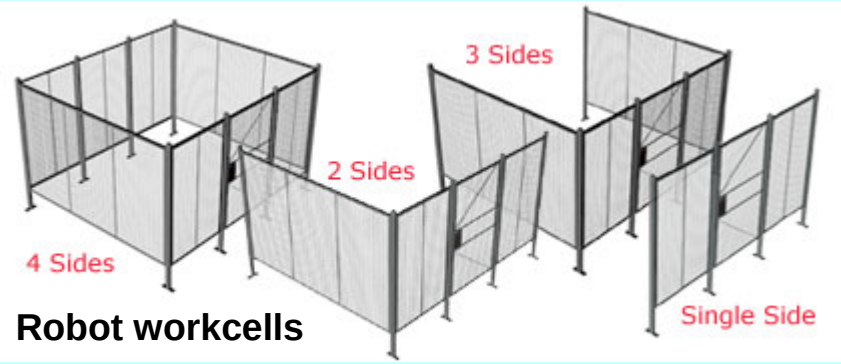
Robot are dangerous: Impacts

Traditional robot applications

- **Powerful machines operating at high speeds and with great precision and dexterity**
- **Designed to operate in workcells separated from humans for safety**

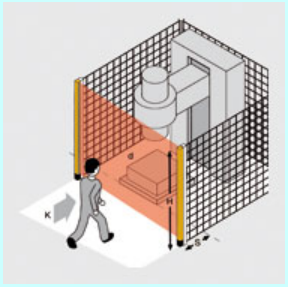


Robot workcells


Traditional robot workcell setup

Human access to the robot's operational space in the workcell is strictly controlled and regulated


Safety switches



Light curtains, lasers and pressure mats, etc

New ways of using industrial robots

KUKA KR500 heavy duty arm

KUKA Robocoaster Robot

Industrial / service robots: Distinctions and future requirements…. SAFETY issues

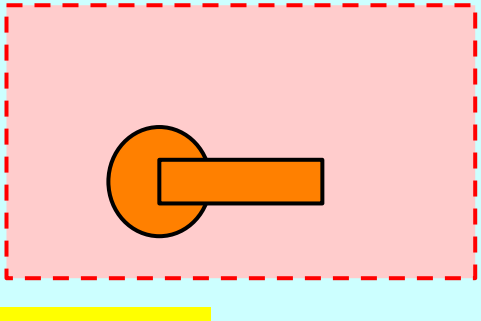
	Industrial Robots	Service Robots
Working environments	Controlled and defined environments	Information structured/ unstructured environments
Users	Training for specified tasks in defined environments	Training to cover wide range of tasks in info structured/ unstructured environments
Safety	Machine dependent (ISO 10218-1)	Dependent on the robot and the user (ISO 13482)
Working philosophy	To keep robots and humans separated (see ISO 10218-1, -2; ISO TS 15066)	Robots and humans must share workspace for providing/ receiving the services (see ISO 13482)
Machine design	Flexible on commissioning for defined task	Flexible on demand for generic tasks/ users

Need:

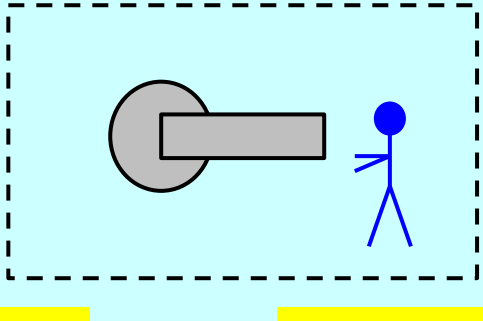
- **Flexibility**
- **Usability**
- **Safety**
- **Human-Robot Collaboration**
- **Effectiveness**
- **Reusable**

Trends in industrial robotics

Conventional industrial robots



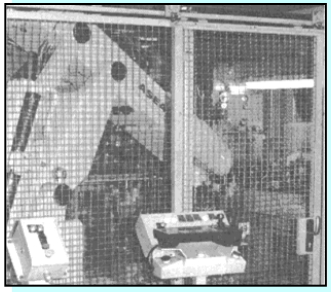
Collaborative industrial robots

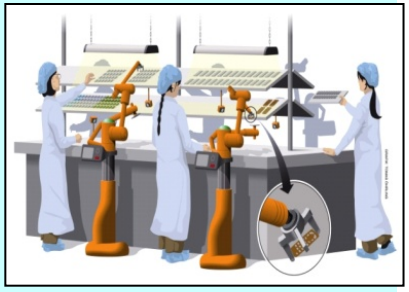


Discrete safety
→ No HRC

Safety controllers
→ Limited HRC

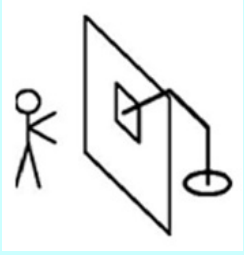
Harmless manipulators
→ Full HRC





Absolute separation → **Mixed environment**

ISO 10218-1, -2; 2011
ISO TS 15066: 2016



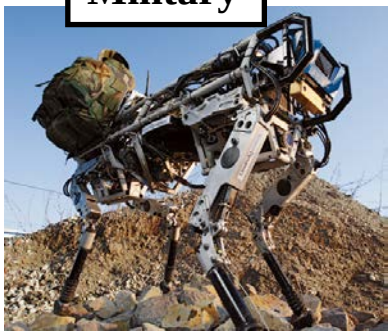
Hand over window

Expansion of robots to society

Manufacturing

Domestic

Military



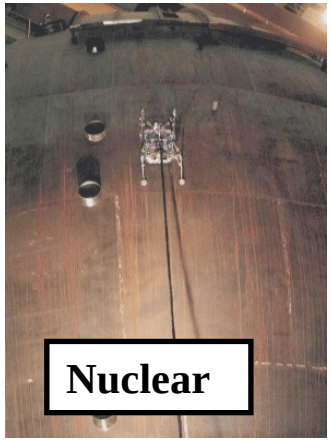
Medical

Collaborative

INDUSTRIAL - SERVICES

Mobile servant

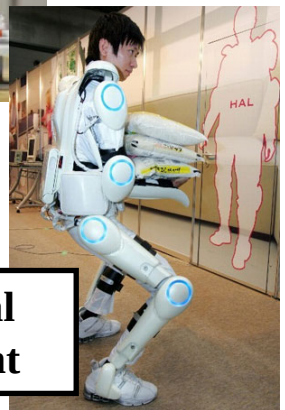
Surgery



Nuclear

Security

Person carrier



Physical assistant

InnotecUK Overview

Innovative Technology & Science Ltd: Setting Standards for Robotic and Automated Solutions

- **Vision Statement**
  - **To set standards in Robotic and Automated solutions through innovation, quality and commitment**
- **Mission Statement**
  - **To develop innovative products and services to meet growing requirement of our clients through knowledge transfer from R&D Projects**

About InnotecUK

- **InnoTecUK was incorporated in 2009 and it has grown to having 22 employees and a turnover of £1.9 million in 2015 (now 26 staff)**
- **It is a progressive company with extensive networks and detailed expertise in Robotics, Automation, Sensors and Non-destructive testing (NDT)**
- **Focus was on developing new technology for NDT applications via R&D projects in UK & EU**
- **Future emphasis on product and service development and new robot applications (medical and non-medical sectors)**
  - **First products(?): HUNTER, VORTEX, MAJIC**

Main business focus currently: NDT

- **Non destructive testing equipment and Service market will grow by 8.96% between 2014 and 2020 and will reach $6.88 billion by 2020.**
- **Key driving factors for growing NDT markets are**
  - **Ageing Infrastructures**
  - **Strict safety regulations**
  - **Rapid growth of new Infrastructures**
  - **Integration of new NDT techniques**
  - **Need of reliable, accurate, cost effective and real time information**

Power lines

Petrochemical

Buildings & structures

Oil tanks

Power stations

Ship hulls

Use of robots in NDT

- **Industry demands simpler and more effective NDT systems**
- **Robotic Inspection system is a combination of powerful Hardware, Software enabling the integration of complete inspection process such as, teaching-probing, scan path generation, post processing, 3D simulation, data acquisition, data analysis and reporting in unified environment.**
- **Key benefit of using Robot Vs Traditional Manual Inspection**
  - **Increase in Accuracy**
  - **Repeatability**
  - **Reliability**
  - **Cost saving**
  - **Flexibility**
  - **Use in Hazardous environment without risking operator's life**

R&D project involvement since 2009

1. TIdalSense: Condition Monitoring System for Tidal Stream Generators
2. UltraCleanPipe: Ultrasonic detection and removal of fouling inside industrial and domestic pipes
3. ICARUS: An ICT Enabled Approach to Optimising the Reliability of Manual Ultrasonic Non-destructive Testing
4. IntelWind: Development of an intelligent condition monitoring system for application on critical rotating components of industrial-scale wind turbines
5. CraneInspect: Continuous Reliable Advanced Novel Efficient Structural Health Monitoring system for crane inspection applications
6. MoorInspect: Development of an advanced medium range ultrasonic technique for mooring chains inspection in water
7. AutoInspect: Automated inspection for sintered parts by non-destructive techniques for improved quality in production
8. MagnaSense: Magnetostrictive sensor applications for self-sensing of composite structures
9. TidalSense Demo: Demonstration of a Condition Monitoring System for Tidal Stream Generators
10. CORETO: Adapted Composite Repair Tooling for in-situ wind turbine blades structural rehabilitation
11. ComoRail: An integrated wayside condition monitoring for axle bearings
12. WinTur Demo: In-situ wireless monitoring of on – and offshore WINdTURbine blades using energy harvesting technology
13. CleanShip: Prevention and detection of fouling on ship hulls
14. SkinDetector: Application of the innovative data fusion based non-invasive approach for management of the diabetes mellitus
15. PolyTank: Development and Validation of an automated Ultrasonic system for the Non-Destructive Evaluation (NDE) of welded joints in thermoplastic storage tanks
16. PigWaves: In-Line Service For Internal Inspection Of Unpiggable Buried Oil Pipelines Using Long Range Ultrasound Guided Waves In Fifty Metre Segments
17. CleanMine: Ultrasonic Cleaning of Valves in Mining
18. DashWin: Development of Advanced Shearography System for On-Site Inspection of Wind Turbine Blades
19. HotPhasedArray: High Temperature Pipe Structural Health Monitoring System utilising Phased Array probes on TOFD configuration
20. SafeHPower: Continuous monitoring systems for the SAFE storage, distribution and usage of Hydrogen POWER for transport
21. AutoWinSpec: Automated mechanical property and fatigue life assessment of composite wind turbine blades in less than 4 hours
22. QualiNET: Automated in-line inspection and quality control of net shape powder metallurgy components using microfocus three dimensional x-ray computed tomagraphy imaging
23. VortexScan: Vortex Robot for Rapid Low Cost Scanning and Improved Non-Destructive Testing of Large Concrete Structures
24. AutoDISC: Automated ultrasonic inspection of aerospace composites with enhanced defect detection probabilities aided by gantry deployed, CAD controlled robotics
25. SubCTestDemo: Development of novel Non Destructive Testing (NDT) techniques and autonomous robots to be deployed by Remote Operating Vehicles for the sub-sea inspection of offshore structure welds – DEMOnstration
26. NUTHIC: Non-contact ultrasound inspection machine for highly integrated composite parts
27. AssureNET: Automated 100% production quality assurance of net shape manufactured components using inline micron resolution x-ray stereographic imaging
28. MANTIS: Cyber Physical System based Proactive Collaborative Maintenance
29. RiviT: Onset of crack propagation at difficult to access doubler repaired aircraft panels
30. SafeAST: Continuous structural condition tank integrity monitoring of Above Ground Storage Tanks, aka “SafeAST, no entry: no empty.”
31. HiTClean: High Temperature Inspection & Cleaning by Advanced Ultrasonics for Effective Maintenance and Management of Oil & Gas Offshore Production subsea & topside operating pipelines and vessels
32. TankRob: In-service intrusive Non-Destructive Testing of above ground and underground petrochemical storage tank floors and walls to detect corrosion
33. RiserSure: Rapid Integrity Assessment of Flexible Risers for Offshore Oil and Gas Installations (started Dec2016)
34. VA-RCM: Innovative Product for train door condition monitoring based on vibration analysis algorithms (started Dec 2016)
35. UltraHotTest: In-situ test of high temperature pipes in nuclear power plant
36. UltraMat: Power ultrasound as a generic tool for micro/nanoscale processing of metals

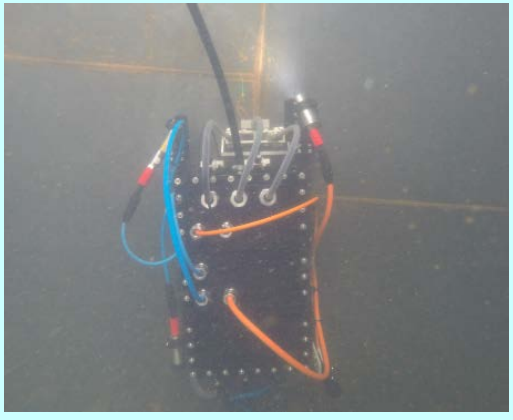
Example R&D projects (1)

MAJIC robotic NDT inspection on ship hulls

Consequences of failures of ship hulls



Crawler robot+umbilical+operator console+NDT+positioning system

MAJIC early testing

MAJIC Final demo

Example R&D projects (2)

HUNTER robotic NDT inspection on wind turbines

Consequences of failures in wind turbines

Magnetic wheeled climbing robot with payload of 10kg

HUNTER movie

Example R&D projects (3)

VORTEX robotic NDT inspection on walls

Consequences of failures: Concrete, glass, blocks, etc walls

Impeller driven adhesion design for climbing walls

VORTEX movie

THE END