



LaserPipe

Remote in-bore laser welding of industrial pipelines

A collaborative project investigating the feasibility of in-bore pipe welding using industrial lasers, integrated with snake-arm robots for industrial applications.

DEFINE

Business Case

Modern industrial sites often require regular maintenance to replace or repair deteriorated pipes. With limited external access available, external orbital welding is not viable for many applications, therefore in-bore remote processing has many significant advantages.

Objectives

Integrate an industrial high-powered laser with a snake-arm robot to demonstrate:

- Remote location of weld joint
- Alignment of laser with weld seam
- Determine in-bore laser welding parameters
- Demonstrate welding capability

DESIGN



Series II, X125 snake-arm robot

Snake-arm robot

OC Robotics snake-arm robots are highly flexible, rope driven robots ideal for working in confined and hazardous spaces.

A Series II, X125 snake-arm robot was integrated with the laser welding head and alignment system.

The snake-arm robot was 2.5m (8.2') long, 125mm (5") in diameter and capable of carrying a 11lbs payload.

Laser welding tool

TWI conducted initial in-bore welding trials to identify the following weld parameters for the project, using COTS hardware.

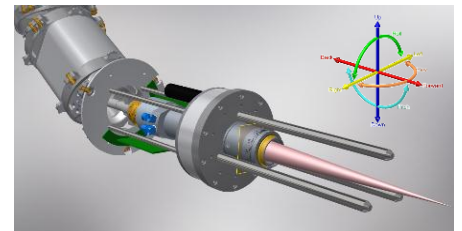
- Laser Power - 4kW
- Weld traverse speed - 1m (3.3ft)/min
- Tolerance - 0.2mm (0.008")



TWI in-bore welding trials

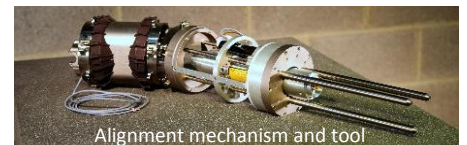
Alignment mechanism

The alignment mechanism provides 6 degrees of freedom with a high resolution of movement to deliver the identified weld parameters using an integrated hardware and software based solution.



Alignment mechanism on snake-arm (render)

Using laser pointers and an integrated camera the tool locates the joint using a 3-point method.



Alignment mechanism and tool

DELIVER Results

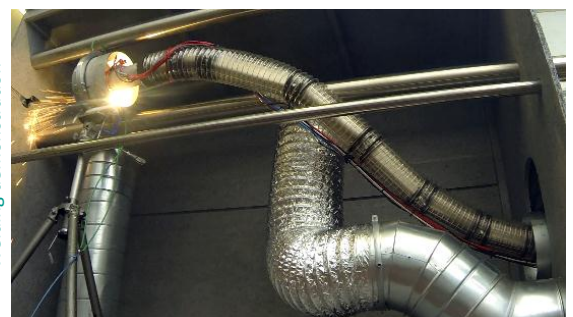
Operating in a mock-up, the LaserPipe system navigated the environment before reaching the weld site, where a successful, full penetration weld was achieved.



LaserPipe Demonstration Video



LaserPipe in operation



Welding demonstration

Conclusion

The project successfully and conclusively demonstrated the feasibility of in-bore laser welding using snake-arm robot technology for delivery and alignment.



LaserPipe is led by OC Robotics, with partner TWI. The project is part funded by Innovate UK.