

When *PE* first met OCRobotics nearly three years ago the company was a three-man team squirreled away, not quite in the garden shed but not that far off, in a double garage converted for the purpose.

Since then the company has moved on to new offices in the centre of Bristol and has doubled its number of employees. Along the way it has won a number of DTI Smart awards and attracted some serious venture capital backing.

The technology at the root of the company began as university research, but has now grown into commercial products – snake-arm robots. And the best measure of any successful spin-out company has to be in the number of commercial contracts.

OCRobotics has so far notched up contracts with the MoD to develop a snake-arm robot for bomb disposal, robots to build aircraft for Airbus, and a Darpa (Defense Advanced Research Projects Agency) funded contract with Clemson University in South Carolina in the US.

The project most recently completed was with Uddcomb Engineering for a Swedish nuclear utility company, Ringhals. The company needed to repair pipework buried deep within Ringhals 1 – a boiling water reactor system – without having to dismantle everything in the way.

OCRobotics' managing director Dr Rob Buckingham says that the problem stemmed from nuclear reactors outliving their original design life of 30 to 40 years.

"The company was reluctant to dismantle the reactor just to repair some pipes when faced with the huge risk that they might never be able to rebuild it and bring it back on line," he says.

Even given the timescale of just six months, and despite the fact that the project specifications changed two months in, OCRobotics showed it was up to the task. A few weeks ago the firm achieved formal factory acceptance at Ringhals 1 for the six robots supplied.

### Up to the task

"This was our first contract where the user was more interested in what the robots do than how they work," Buckingham says. "The six robots we designed and built or, more accurately, five robots and one complete set of spares, had to work perfectly first time, as there was no time even for prototypes."

According to Buckingham, the pipes in question could be accessed from two directions, but each

direction had very different requirements. The first was from the room below, through 62mm diameter holes in a 150mm thick stainless steel floor, and the second a more convoluted route along an 82mm wide, 3m long corridor with other pipes to circumnavigate at the end.

Added to this, the first robot had to travel 4m vertically upwards before even reaching the steel floor. The result was a snake-arm robot for each: an underneath arm and an overhead arm.

### Two-pronged effort

"The underneath arm is the bendier of the two snake-arms and has a diameter of 35mm to get it through the 62mm hole. Its task was to get cameras into position to guide the overhead arm but, in fact, cameras on the overhead arm were first used to guide the underneath arm." In other words, co-operation was the name of the game.

Co-operation runs much deeper within OCRobotics than making robots that work together. With only six people on the staff the company is not yet big enough to realise Buckingham and fellow founder Andrew Graham's dreams of doubling in size again and operating from a mixture of office and workshop space.

Buckingham elaborates: "We've been very fortunate to work very closely with our subcontractors, so we've been able to benefit from their highly skilled staff. In fact, through an agreement with our main contractors, our current manufacturing operations are located in a corner of their facilities."

Snake-arm robots are so called because the arm follows the path taken by the tip. This is made possible by lots of joints that closely resemble those in the human spine.

Most robots have six degrees of freedom, but the overhead arm has 13 and the underneath arm 23, making them perfect for "reaching the unreachable" as Buckingham puts it. Driven by a twin control joystick control pad, the robot tip also carries the tools needed for the job. The overhead arm for instance can pick up a variety of tools and position them with a precision better than 50µm.

Buckingham is fully aware that the company is still in the chicken and egg stage, acknowledging that several things have to happen at the same time in order for them to move forward and grow. It's a slow process but, as its current order book shows, the firm is in it for the long haul.



# Snaking advantage

*Helen Wraige* visits a six-man band that has managed to develop and produce robots which can position a tool to within 50µm in incredibly hazardous environments

Joint efforts: Mock-up of the lower arm snaking through the floor of the reactor facility