

# HANDS, KNEES, AND...



**Manoeuvrability,  
anthropomorphism  
and networking are  
enhancing robot  
performance.  
By Graham Pitcher.**

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## More manoeuvrability

Robotic functions can be enhanced by improving their manoeuvrability. One company pursuing this approach is Intelligent Systems Solutions (Insys). Here, Dr Cliff Boddy is leading a project, supported by BNFL, to develop a dextrous manipulator system. The key to this device is adding extra degrees of freedom - actuated joints - to a robot's arm.

According to Dr Boddy: "A seventh degree of freedom, for example, makes the robot act much more like a human arm." The seventh degree of freedom comes from the addition of an extra roll function at the shoulder. A six degree of freedom robot generally features roll and pitch only at the shoulder. Dr Boddy notes: "The arm also has an offset elbow, which allows it to double back on itself."

With seven or more degrees, the manipulator can offer much better freedom enabling improved accessibility in a confined space, or simultaneously carry out end effector tasks and collision avoidance or joint limit avoidance.

A feature of the dextrous manipulator system is a collision avoidance system. The system comprises an array of capacitive and infrared sensors from the shoulder outwards. "This is being updated with a radiation hardened capacitive proximity sensor system," Dr Boddy adds.

The benefit of the system is that, because of the seventh degree of freedom, the arm can, with the aid of software, plan its motion through restricted spaces. This ability makes the arm attractive to users in, for example, the nuclear industry, where it is being considered for maintenance activities.

The radiation hardened system uses a series of metal plates to form the capacitive sensor array. The sensors measure the capacitance to earth. If an earthed object moves into the sensor's range, the capacitance alters and can be measured. Dr Boddy adds: "The nearer you get to the object, the better the reading."

The Insys system, however, does not require accurate measurements but, as Dr Boddy notes: "If you can generate an approximate reading of the distance to the nearest object, the control system can generate movement to take the arm away."

The robot is being controlled by a vme system. This comprises i960 processors, with the arm's drive amps being sent position commands from the vme system.

## Artificial hands

End effectors are an important aspect, particularly if they are to be used with 'human replacement' robots.

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**R**obotics was once looked upon as the technology which would free workers from the drudgery of the daily grind. Despite the high hopes, today's robots don't have the profile once predicted for them. It's not the industrial devices that have gained kudos, it's their show business counterparts. How about Marvin, the paranoid android, in 'The Hitchhiker's Guide to the Galaxy'? Or Robbie the Robot in 'Lost in Space'? Or R2D2 in 'Star Wars'? Memorable images, certainly, but probably not what the robotics industry had in mind.

The industry has generally pursued a path of developing robots which emulate the

human form. The robot may have one or two 'arms', it can also come with such features as 'wrists', 'elbows' and 'fingers'. Further enhancements add vision, and capable end effectors with force and tactile feedback.

More complex research has tried to make robots look and act even more like humans by developing autonomous devices with two arms and stereoscopic vision systems. This work's aim is to provide an intelligent device capable of performing relatively complex product assembly. Fanuc, for example, is one company which has developed such a robot, taken it out of the laboratory and put it into its Japanese factory in the shadow of Mount

Fuji. Here, appropriately enough, the device is being used to assemble robots.

Bob Lloyd, chairman of the British Robot Association, says robots have developed from the early days of arms only, to the point where the devices are being built to undertake specific functions. The combination of effectors, physical design and controller is making these robots appropriate to particular tasks only. This approach brings more effective devices.

However, the industry isn't always at the cutting edge. Robots designed in the early 1970s are still the device of choice in a number of applications (see breakout box).