

Robots use their hands to 'think'

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Action-centred cognition is a groundbreaking concept in robotics where robots learn to 'think' in terms of what actions they can perform on an object. This new trend in cognition theory opens exciting new vistas.

Actions speak louder than words, particularly if you are a [robot](#). At least that is the theory proposed by a major European effort to develop a wholly new approach to robotic cognition.

The [PACO-PLUS](#) project sought to test a groundbreaking theory called 'object-action complexes' (OACs, pronounced 'oaks'). OACs are units of 'thinking-by-doing'. Essentially, this approach designs software and hardware that allows the [robot](#) to think about objects in terms of the actions that can be performed on the object.

For example, a robot can look at anything. If an object has a handle, the

robot can grasp it, too. If it has an opening, the robot can potentially fit something into the opening or fill it with liquid. If it has a lid or a door, the robot can potentially open it.

Thus, objects gain their significance by the range of possible actions a robot can execute upon them. This opens up a much more interesting way for robots to think autonomously, because it fosters the possibility of emergent behaviour, complex behaviours which arise spontaneously as a consequence of quite simple rules.

Absurdly simple complexity

Our universe demonstrates astounding complexity from a handful of universal constants and DNA consists of just four bases, but from these all lives emerge. Researchers at PACO-PLUS hope to imitate to some degree that level of complexity, the complexity that arises from the absurdly simple.

In some respects, their approach imitates the learning processes of young infants. As they encounter a new object, infants will try to grasp it, eat it, or bang it against something else. As they learn from trial and error that, for example, a round peg will fit into a round hole, the range of actions enlarges.

Watching other people, too, adds to a child's understanding and next the child starts using actions in combination, such as grasping a door handle and then twisting it, to accomplish a more complex goal.

PACO-PLUS takes advantage of all these proven strategies to enable robots to teach themselves by learning from their observations and their experience. As a key part of that strategy, PACO PLUS conducted most of its work with Humanoid robots, robots shaped like people.

“Humanoid robots are artificial embodiments with complex and rich perceptual and motor capabilities, which make them... the most suitable experimental platform to study cognition and [cognitive](#) information-processing” explains Tamim Asfour, leader of the Humanoids Research Group at the Institute for Anthropomatics at Karlsruhe Institute of Technology (KIT) Germany, and co-coordinator of the PACO-PLUS project.

I am therefore I think

"Our work follows on from Rodney Brooks who was the first to explicitly state that cognition is a function of our perceptions and our ability to interact with our environment. In other words, cognition arises from our embodied and situated presence in the environment."

Brooks, who published his most influential work in the 1980s, believed that moving and interacting with the environment were the difficult problems in biological evolution; once a species achieved that, it was relatively easy to ‘evolve’ the high-level symbolic reasoning of abstract thought. Brooks believed that disembodied intelligence was an impossible problem to solve.

This reverses the approach taken by ‘artificial intelligence’. AI believes if you develop enough intelligence, machine thought will be able to perceive and solve problems; robotic cognition believes that if you develop useful perception and interaction, intelligence will emerge spontaneously.

The jury is still out on who is right, but the robotic cognition school has biology on its side, and now it has the work of the PACO-PLUS project, too.

While progressing, there are no genuine I, Robot candidates on the scene

yet. That Hollywood interpretation is still a ways off, but the applications and demonstrators built by PACO-PLUS show that we are now, perhaps, on the right track.

More information: *This is the first of a two-part PACO-PLUS feature.*
[Part 2.](#)

Provided by ICT Results

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