New trends in intelligent robotics applied to the laboratory: towards *analytical robotics*

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1. The New Robots are Coming

ABSTRACT: While robotics systems have been useful tools in the laboratory for many years, most notably in the area of liquid handling, many tasks are still little automated. At the same time a new wave of robotic devices is reaching the market - from robot lawn-mowers to driverless cars as well as smarter robots in manufacturing.
These benefit from the latest advances in mechatronics, sensors and artificial intelligence algorithms. Many of these advances are taking place in Europe thanks to ambitious public funding programmes and a dynamic robotics research community. This poster highlights some of the latest advances in robotics with the potential to take laboratory automation and the science it enables to the next level.

SPARC
The Partnership for Robotics in Europe

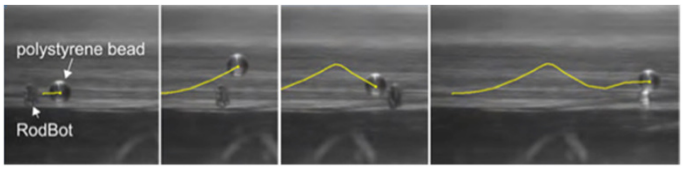
Since the role of the scientific laboratory is to obtain information and insight into the samples presented, analytical instruments lie at its heart. The robotics systems supporting these instruments could therefore be termed "**analytical robotics**".

A **working group** on **laboratory robotics** has been established to promote the area [1] within euRobotics /SPARC, the mechanism which guides European Research funding.

2. New Robots for Old Tasks

Protein Crystallisation: RodBots are rod-shaped, magnetically responsive micro-robots (typically 50um by 50um by 300um) that roll on a supporting surface and induce fluid flow in the surrounding solution. These localized flows can pick up and transport crystals and place them onto a loop or other extraction device. Manipulation is thus done in a non-contact manner and the gentle, distributed fluid forces safely deliver fragile protein crystals to their destination [2].

www.magnebotiX.com



Other routine and repetitive tasks are also attractive targets for automation , especially those involving solids materials and samples . These include:

- Preparing stock solution, automatically handling a range of container types
- Handling laboratory rodents [3], taking blood from laboratory rodents

Improved manipulation

3. New Tasks Require New Capabilities

The next generation of robotics will be more social, interacting better with users and with one another. Using technologies from other areas of robotics, they will be cheaper, and there will be more of them. They will be **collaborative robots** or co-bots

- Human-like manipulation capabilities (agile joints, dual arm, multi-finger)
- Gentle movements with active force control to prevent risk of harm
- Active and passive collision prediction and detection
- No need for users to be fenced off from robots (and vice versa)
- Better combination of user skill and robot repeatability

Learning on the job – robots technology developed for small scale craft manufacturing

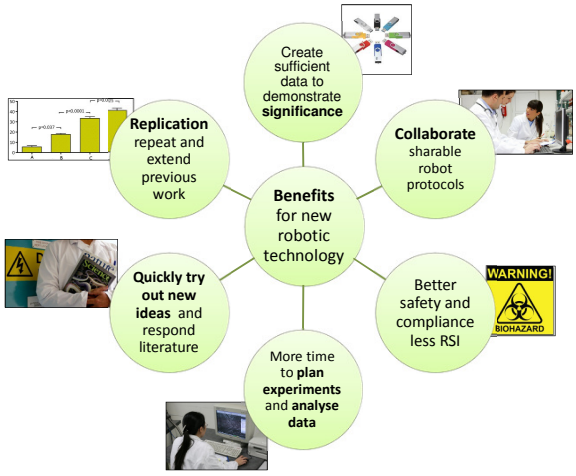
- New modes of collaboration between robotic and users
- Systems learn from users
- Perform repetitive tasks autonomously
- Self-awareness to detect problems
- Guide user to recover and continue

Getting smarter in the lab - future automation will connects all the elements

- Seamless sharing of information between units
- Sharing of protocols between instruments, robots , users and labs
- Tools to analyse data, identify trends and exceptions
- Track adherence to standard operating procedures (SOPs) and safety guidelines

Improved interaction

4. Enabling new science



5. How to get involved

New ways of working – to encourage exploration of the opportunities for using advanced robotics the European Commission has funded a number of open access Robotics Innovation Facilities (RIF) in Bristol, Pisa and Paris. These are open access facilities equipped with latest technology and staffed by competent scientists and engineers. www.echord.eu

Interaction across different fields of robotics - just as laboratory will benefit from advances in robotics driven by other markets such as manufacturing, home automation, so can these other markets benefits from the technologies developed for the lab. For example, liquid handling can be useful in precision weeding for agricultural robotics, and in surgical robotics. Likewise, well established techniques for control of contamination and traceability can benefit food robotics. These interactions may also open up new markets for the existing laboratory automation companies.

The **H2020 research programme** will drive some €3bn to advanced robotics. Help writing grants is available from specialists like PNO.

6. Some example systems

Agile Manipulator Hands

Characteristics

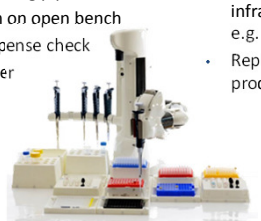
- Replicate manual processes
- Fine control
- Five fingers
- Force control

Shadow Robot

Benchtop Collaborative Robot

Characteristics

- Use of existing pipettes
- Operation on open bench
- Visual dispense check
- Safe to user



Andrews Alliance

Humanoid Robot platform

Characteristics

- Adapt to existing lab infrastructure e.g. glove box
- Replicate human processes

Italian Inst. of Tech.

References

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