UNIVERSITY OF LIVERPOOL

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LivAR: Autonomous Robot Chemists

Mobile laboratory robots that work alongside laboratory staff using pre-existing equipment and consumables.

Please note, header image is purely illustrative. Source: NIH-NCATS, Flickr, CCby2.0 (https://www.flickr.com/photos/64860478@N05/5964663649)

Seeking

Development partner, Seeking investment

About **University of Liverpool**

By facilitating access to our expertise, facilities and networks, the University of Liverpool offers the means to transform ideas into creative solutions, improved performance, new technologies, strategies, applications, products or skills.

Background

There is an urgent need for faster, more powerful and safer approaches to chemical and materials research. This is driven by a societal need (new chemical solutions for societal problems) and an economic pull (the chemicals sector accounted for £1bn R&D spend in 2016 in the UK alone).

To address this, we have developed mobile autonomous robot chemists, driven by artificial intelligence (AI), as platforms for chemistry and materials research.

The aim of this technology is to find new research solutions on timescales that are hundreds of times faster than traditional approaches. Equally important, these platforms are designed to create highly complex materials and formulations with multiple components that would perhaps never be discovered using traditional methods on any timescale.

YouTube

Tech Overview

Researchers at the University of Liverpool have developed a new approach to laboratory automation: the world's first autonomous mobile robotic chemist. Liverpool Autonomous Robotics (LivAR) commercial mobile robots work in laboratories alongside laboratory staff using pre-existing equipment and consumables. This differs fundamentally from hardwired automation approaches, where each instrument needs to be physically connected, and as such, the LivAR approach is around a tenth of the cost. The approach has been developed to the proof-of-principle stage with a demonstrator robot running in our Autonomous Chemistry Laboratory (Figure 1).

While commercial robotic platforms for chemistry already exist (as supplied by Chemspeed, HTE, and others), very few have the capability to do fully autonomous research. Where fully autonomous platforms do exist, they tend to be hardwired to carry out a specific application test, such as paint formulation. They also have limited AI, and they are typically expensive (>£5M).

The LivAR system, by contrast, is intrinsically reconfigurable: rather than being hardwired, the robots can use existing lab instruments just like a human researcher, with no hardware modifications, in a regular laboratory.

Benefits

- **Cost** – fully automated, hardwired robotic solutions for materials discovery can cost £5–10M or more; by contrast, the LivAR equipment costs less than £250k.
- **Flexibility** – for _n_ experimental stations, there are (_n_-1)! possible ways to access each station once. For 10 stations, this equates to 362,880 different routes. It is impossible to address this level of complexity with hardwired robotics, but with mobile robots, each of the 362,880 routes is equally fast.

- **Modularity** – with hardwired robots, adding a new instrument presents a costly integration challenge. With this mobile solution, integration can be very easy.
- **Human–robot cooperation** – some complex processes are hard to automate, and this may not be worth the investment, particularly for shorter experimental campaigns. This mobile solution is easily integrated into workflows where human researchers carry out some of the tasks alongside the robots (or 'cobots').

Applications

Laboratory robotics is a rapidly developing industry. Currently the market is addressed through complex closed systems that are expensive and slow to develop, and inflexible. These systems are however ideally suited to high-throughput routine analysis carried out over long periods. The LivAR system introduces flexibility, reduces cost, and addresses the area of the market between existing robotic systems and skilled technicians carrying out assay development and bespoke, complex work. University of Liverpool researchers are therefore aiming at the routine work currently carried out by technicians and more bespoke work beyond robotic systems currently available.

Opportunity

The university is looking for development partners and investors to help complete development.

Appendix 1

Figure 1