

# The Zenith

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# Portable electronics: A stretchable and flexible biofuel cell that runs on sweat

A unique new flexible and stretchable device, worn against the skin and capable of producing electrical energy by transforming the compounds present in sweat, was recently developed and patented by CNRS researchers from l'Université Grenoble Alpes and the University of San Diego (USA). This cell is already capable of continuously lighting an LED, opening new avenues for the development of wearable electronics powered by autonomous and environmentally friendly biodevices. This research was published in *Advanced Functional Materials* on September 25, 2019.

The potential uses for wearable electronic devices continue to increase, especially for medical and athletic monitoring. Such devices require the development of a reliable and efficient energy source that can easily be integrated into the human body. Using "biofuels" present in human organic liquids has long been a promising avenue.

Scientists from the Département de chimie moléculaire (CNRS/Université Grenoble Alpes), who specialize in bioelectrochemistry, decided to collaborate with an American team from the University of San Diego in California, who are experts in nanomachines, biosensors, and nanobioelectronics. Together they developed a flexible conductive material consisting of carbon nanotubes, crosslinked polymers, and enzymes joined by stretchable connectors that are directly printed onto the material through screen-printing.

The biofuel cell, which follows deformations in the skin, produces electrical energy through the reduction of oxygen and the oxidation of the lactate present in perspiration. Once applied to the arm, it uses a voltage booster to continuously power an LED. It is relatively simple and inexpensive to produce, with the primary cost being the production of the enzymes that transform the compounds found in sweat. The researchers are now seeking to amplify the voltage provided by the biofuel cell in order to power larger portable devices.

<http://www.cnrs.fr/>  
[www.sciencedaily.com](http://www.sciencedaily.com)

# Driverless cars working together can speed up traffic by 35 percent

A fleet of driverless cars working together to keep traffic moving smoothly can improve overall traffic flow by at least 35 percent, researchers have shown.

The researchers, from the University of Cambridge, programmed a small fleet of miniature robotic cars to drive on a multi-lane track and observed how the traffic flow changed when one of the cars stopped.

When the cars were not driving cooperatively, any cars behind the stopped car had to stop or slow down and wait for a gap in the traffic, as would typically happen on a real road. A queue quickly formed behind the stopped car and overall traffic flow was slowed.

However, when the cars were communicating with each other and driving cooperatively, as soon as one car stopped in the inner lane, it sent a signal to all the other cars. Cars in the outer lane that were in immediate proximity of the stopped car slowed down slightly so that cars in the inner lane were able to quickly pass the stopped car without having to stop or slow down significantly.

Additionally, when a human-controlled driver was put on the 'road' with the autonomous cars and moved around the track in an aggressive manner, the other cars were able to give way to avoid the aggressive driver, improving safety.

The results, to be presented today at the International Conference on Robotics and Automation (ICRA) in Montréal, will be useful for studying how autonomous cars can communicate with each other, and with cars controlled by human drivers, on real roads in the future.

"Autonomous cars could fix a lot of different problems associated with driving in cities, but there needs to be a way for them to work together," said co-author Michael He, an undergraduate student at St John's College, who designed the algorithms for the experiment.

"If different automotive manufacturers are all developing their own autonomous cars with their own software, those cars all need to communicate with each other effectively," said co-author Nicholas Hyldmar, an undergraduate student at Downing College, who designed much of the hardware for the experiment.

The two students completed the work as part of an undergraduate research project in summer 2018, in the lab of Dr Amanda Prorok from Cambridge's Department of Computer Science and Technology.

Many existing tests for multiple autonomous driverless cars are done digitally, or with scale models that are either too large or too expensive to carry out indoor experiments with fleets of cars.

Starting with inexpensive scale models of commercially-available vehicles with realistic steering systems, the Cambridge researchers adapted the cars with motion capture sensors and a Raspberry Pi, so that the cars could communicate via wifi.

They then adapted a lane-changing algorithm for autonomous cars to work with a fleet of cars. The original algorithm decides when a car should change lanes, based on whether it is safe to do so and whether changing lanes would help the car move through traffic more quickly. The adapted algorithm allows for cars to be packed more closely when changing lanes and adds a safety constraint to prevent crashes when speeds are low. A second algorithm allowed the cars to detect a projected car in front of it and make space.

They then tested the fleet in 'egocentric' and 'cooperative' driving modes, using both normal and aggressive driving behaviours, and observed how the fleet reacted to a stopped car. In the normal mode, cooperative driving improved traffic flow by 35% over egocentric driving, while for aggressive driving, the improvement was 45%. The researchers then tested how the fleet reacted to a single car controlled by a human via a joystick.

"Our design allows for a wide range of practical, low-cost experiments to be carried out on autonomous cars," said Prorok. "For autonomous cars to be safely used on real roads, we need to know how they will interact with each other to improve safety and traffic flow."

In future work, the researchers plan to use the fleet to test multi-car systems in more complex scenarios including roads with more lanes, intersections and a wider range of vehicle types.

*University of Cambridge*  
*[www.sciencedaily.com](http://www.sciencedaily.com)*

## Expert Lecture/Seminars/Courses/Industrial Visits Organized

- An Expert lecture was organized on "Opportunities in industrial automation" on 1st August 2019. Mr. Anand Thakar (Sr. Consultant, CAD-CAM GURU, Pune) was the resource person.



- An Expert lecture was organized on "Project selection, effectiveness and execution" on 16th July 2019. Mr. Sandeep Karkhanis (Deputy General Manager, BOSCH, Nashik.) was the resource person.



- An Expert lecture was organized on "Applications of signal processing using MATLAB" on 13th July 2019. Mr. Pawankumar Fakatkar (Mathworks India Pvt.Ltd. Bangalore) was the resource person.



- An Expert lecture was organized for SE students on "Opportunities through GATE-EC and M. Tech" on 20<sup>th</sup> July 2019 under the Career Development Cell. Mr. Sushil Kumar Suman (Qualified in Engineering Service Exam, UPSC) Mumbai was the resource person.



- An Expert lecture was organized for TE students on "Opportunities in Govt. and Private Sector" on 31<sup>st</sup> August 2019 under the Career Development Cell. Mr. Vinod R. Patil (Probationary Officer, IRSSE, Secunderabad) was the resource person.



## Workshop

- A two days workshop on Application of MATLAB & SIMULINK in Engineering Applications was organized in association with Mathwork & DesignTech Pune on 12th and 13th July 2019.



- Hands-on Workshop on Antenna & Microwave Integrated Circuits was conducted on 22nd July 2019. Mr. Anirudha Kulkarni (Development Manager, MUMLAB Technologies, Navi Mumbai) was the resource person.



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