ENERGIZING POWER MANAGEMENT

For decades, the electronics industry has been driven by "Moore's Law", a forecast that transistors on a microchip would keep doubling every two years, making faster, smaller, and cheaper devices continuously available. But as the smallest feature size for making a transistor has reached an almost unbelievable 5 nanometers, and that a transistor must at least measure a few nanometers to physically exist, Moore's Law is finally starting to change.

Instead of targeting size, the hi-tech sector's emerging goal is "More than Moore": an increase in functionality by adding device capabilities to the "brain" provided by the decision-making transistors. This could be in the form of sensors, or through passive components, as with Prof Johnny Sin's novel technology.

Prof Sin, one of the world's leaders in the microelectronic device field, has become the first globally to design embedded solenoid inductor micro-electronic technology that has been experimentally proven to improve inductor efficiency by 6%. This is a huge saving in energy, given that many current solutions struggle to attain 1% improvement. In addition, the achievement has been accomplished using an area 5.5 times smaller than an "on-chip" inductor placed on the surface of the wafer.

Utilizing this innovation, Prof Sin and his PhD students are now building novel power management integrated circuits to move energy storage and distribution, and the microprocessor industry, forward. Power management is a crucial element of any electronic gadget, acting as the distributor of energy held in the battery or from the mains in the wall and telling the gadget's functional components how to take in that energy. Eventually, such advances should help maximize battery life and reduce recharging of electric vehicles, mobile phones, and other devices.

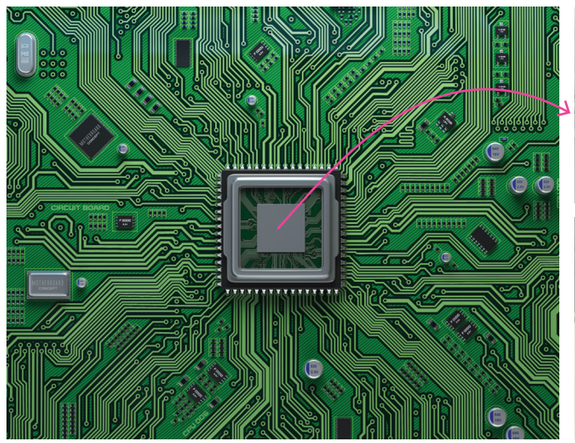
> "Engineering should benefit society by being useful and making life more efficient"
>
> **PROF JOHNNY SIN**
> Professor of Electronic and Computer Engineering

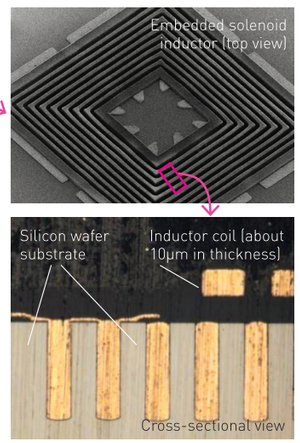
The design work carried out over the past nine years with different PhD students has led to three generations of passive inductor technology. Under development are integrated power inductors for central processing unit (CPU) chips, micro-transformer chips for high-voltage isolated signal and power transfer, and integrated inductors for mobile and wearable electronics.

Confident that the team's ideas had major global commercial potential, Prof Sin and his first-generation PhD student Rongxiang Wu, now an academic at the University of Electronic Science and Technology of China in Chengdu, Sichuan, and third-generation PhD student Sherman Fang, decided to form CoilEasy Technologies Ltd to bring their US and China-patented technology to market. They also gained support for two consecutive years from the Hong Kong government's Technology Start-up Support Scheme for Universities (TSSSU).

CoilEasy is now working with major companies in Mainland China and the US to turn its technologies into products. The company's US collaborator is GlobalFoundries, which is among the largest semiconductor manufacturers in the world. Its Chinese industry partner Mornsun Guangzhou Science & Technology, located in Guangdong Province, is one of the largest power supply module vendors in China, with a worldwide distribution network. Earlier this year, CoilEasy completed its seed round for funding, receiving positive feedback from both investors and market.

For manufacturers, the advances are expected to add just four post-CMOS (fabrication) lithographic steps among the hundreds of other regular steps in the process of integrated chip production, making the power management improvements straightforward to incorporate and cost effective to implement.





HKUST's Embedded Solenoid Inductor Design improves inductor efficiency by 6%, compared with current solutions that struggle to attain 1% improvement. It also uses an area 5.5 times smaller than that of the conventional "on-chip" design.

The HKUST researchers' key innovation lies in the novel structure of the inductor, designed in a way to lodge the coil structure of the inductor within the silicon wafer substrate. This has provided a robust base for the component while keeping the essential smoothness of the chip surface, improving magnetic film performance, and reducing resistance and hence power loss.

WHERE AM I?

Step by step, turn by turn, the app-based pathfinder can point the way to where you want to go in an unfamiliar building

Getting lost in an airport, shopping center, or hospital will no longer be an excuse for lateness soon, with the arrival of smart mobility app "Wherami". This indoor localization technology, developed by computer scientist Prof Gary Chan, markedly improves accuracy in navigating large buildings, telling people on the move inside where they are and taking them to where they want to go.

Drawing on his expertise in algorithmic and optimization techniques, Prof Chan's navigational software works by combining Wi-Fi with other signals available from a mobile phone, including the geomagnetic field and motion sensor readings. In this way, the software can infer position to a much greater level of accuracy, with an average location error of less than 2.5 meters. This is three times more precise than conventional approaches.

Download the app, and the system simultaneously localizes users and calibrates the sensors. It does so by fusing different signals, rather than using a single source. It also employs an algorithm, devised by Prof Chan and his researchers, that optimizes user location based on the multiple signal readings while effectively mitigating the signal noises.

Prof Chan and his research team spent around four years researching and developing the first-generation app, which is now being deployed in major Hong Kong shopping malls including Harbour City, YOHO Mall and MOKO, as well as the Hong Kong Children's Hospital. It has been licensed to Compathnion, a company co-founded by Prof Chan and his team members.

> "It is rewarding to see how our research results and technology transfer have introduced novel smart city services which impact our lives"
>
> **PROF GARY CHAN**
> Professor of Computer Science and Engineering

Where Are They?

Prof Chan is now undertaking further leading-edge research on people sensing by answering the question "Where are they?" To do this, his team is developing cost-effective Internet-of-Things (IoT) sensors to detect people's movement through signal changes, hence finding people's locations. The system has multiple smart city applications, for example, analyzing and managing crowd flows, and tracking hospital patients and indoor assets.

The multi-award winning technology received a Silver Medal at the 2018 International Exhibition of Inventions of Geneva, among others, and is now being commercialized by Smart Sensing, a separate HKUST start-up, co-founded by Prof Chan in 2018. The company focuses on assisting mall and shop owners to better understand customer traffic, leading to more informed decision-making on business operations.

Prof Chan, a holder of numerous patents, has a strong track record of overcoming Wi-Fi-related challenges. Among his earlier contributions is the development of Lavinet, which eliminates Wi-Fi blind spots by extending coverage through an adaptive multi-hop technology. The system has been deployed at a leading container terminal in Hong Kong.