



THE BIG PICTURE

The vast oceans of digital information now being created could reshape our lives, with the **HKUST Big Data Institute** already fathoming this brave new world

The “Big Data” age is well and truly upon us. Huge sets of information are being accumulated through sensor networks, scientific measurements, financial transactions, medical images, web interactions, and social media, among others. Indeed, 2016 is the year in which global internet traffic is expected to surpass one zettabyte – the equivalent of a trillion gigabytes – and keep on rising.* We now need to know how to mine and analyze what all this information can tell us about the world. It is a development being boldly embraced by the HKUST Big Data Institute.

With data science a targeted area of research excellence at the University, the recently established Institute is set to leverage the leading reputation of HKUST academics to forge an interdisciplinary platform that serves as a springboard for new fields of enquiry and technologies in computer science and beyond. Indeed, the opportunities that big data offers in addressing major global challenges and advancing discipline-specific understanding are huge. The financial world, city living, and e-commerce are just some of the many sectors that stand to benefit.

HKUST faculty’s expertise covers core techniques and technologies to extract, integrate, manage, analyze, visualize, and discover knowledge from large and heterogeneous data sets. Research initiatives range from the use of “deep learning” (building and training neural networks) and “transfer learning” (ability to recognize and apply knowledge learned in previous tasks to novel tasks) to produce biological and health knowledge to the development of algorithms for computer vision applications.

External research partnerships include an agreement with China’s largest integrated IT service provider Digital China Holdings Ltd to explore smart city service provision and the application of big data information technologies. The WeChat-HKUST Joint Lab on Artificial Intelligence Technology also provides HKUST



Top left: Prof Qiang Yang discussing with his research students.

Top right: HKUST signed a Framework Agreement with Digital China to build Smart City Research Institute, September 2015.

Bottom: Plaque unveiling ceremony for the WeChat-HKUST Joint Laboratory on Artificial Intelligence Technology, November 2015.



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The big data world is swimming in information. However, such data will remain just data without ways to extract, integrate, store, compact, retrieve, analyze, and predict from it
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PROF QIANG YANG

New Bright Professor of Engineering, Head, Department of Computer Science and Engineering, and Director, HKUST Big Data Institute, Inaugural Editor-in-Chief of IEEE Transactions on Big Data

researchers access to data generated by 650 million active users for studying artificial intelligence – in particular in areas of natural language processing including speech recognition.

Big data has tremendous potential to open up studies and applications that would otherwise not be possible. Supported by internationally renowned research teams across the Schools of Science, Engineering, Business and Humanities and Social Science, and east-west vision and networks, the HKUST Big Data Institute is well positioned to lead and contribute to this exciting development, both to academia and society. Finding out how the future will be reshaped by those zettabytes of data begins here...

* Cisco® Visual Networking Index (VNI), *The Zettabyte Era: Trends and Analysis*





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3D reconstruction from
photographs is not the end.
It is the beginning!
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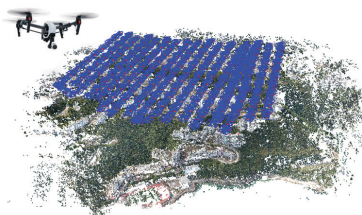
PROF LONG QUAN

Professor of Computer Science and
Engineering, and Director, HKUST
Center for Visual Computing and
Image Science

RECONSTRUCTING THE WORLD IN 3D

Through research into computer vision, the huge amounts of visual data now available are being usefully mined and set to work. This is being achieved through the development of algorithms and technologies for applications such as 3D mapping. With such guidance, we would locate destinations not by today's 2D charts filled with geographical symbols but by our mobile phones equipped with GPS and its visual sensor, the phone camera. Terrain could be known beforehand, assisting rescue missions and expeditions. Urban locations would be revealed as they actually appear, making getting lost in a strange place a thing of the past.

Computer vision expert Prof Long Quan has spent the past two decades driving forward the fundamentals of 3D reconstruction. He was involved in theoretical developments in the 1990s, contributing to many fundamental 3D vision algorithms, including the minimum six-point algorithm from three views and projective reconstruction from multiple views. He also participated in the practical side of 3D modeling by integrating computer graphics algorithms. Since joining HKUST in 2001, he and his team have made exciting advances that include a fully automatic 3D reconstruction methodology from very large numbers of images, and recent algorithms and systems to address the “missing detail” challenge of current technology.



Left: A drone autonomously captures images of the HKUST campus.

Below: 3D mapping technology is used to reproduce images of HKUST campus from different angles.



In this latest move forward, 3D details at ground level that could not be captured before using street-view camera cars, such as side views of buildings, are now made possible by unmanned aerial vehicles (UAVs) and can be merged with low-flying aerial views by fully automated methodologies. The enhanced accuracy this development has provided has created interest among global peers and major companies, including Google, Airbus and Mainland China businesses, Prof Quan said.

Given his focus on visual 3D reconstruction of landscapes, and visual data analysis, Prof Quan is also involved in helping machines understand and recognize what they are seeing. This could be buildings or trees, or whether an object is man-made or vegetation. Such research is intrinsically linked to UAV technology, part of the University's targeted research excellence area of autonomous systems and robotics (see “Flying High” P24). The UAVs and their cameras allow the capture of a large amount of unoccluded visual data for recognition and monitoring as well as 3D reconstruction. HKUST computer vision researchers are seeking to provide autonomous system researchers with better tools to analyze what they are capturing.

In addition, given the capability of 3D measuring, the work heralds a likely revolution in photogrammetry, the science of making measurements by using photographs, often aerial ones, to survey and map terrain. In line with this, the HKUST start-up launched by Prof Quan's group has recently enabled the online cloud platform, altizure.com, through which the ambitious objective of mapping the world using drone photographs may be realized.