



Anil Kumar JAIN 教授
Prof. Anil Kumar JAIN

工程學榮譽博士
 Doctor of Engineering *honoris causa*

Next time you open your mobile device with a simple touch of your finger, think of Prof. Anil K. JAIN whom we honor today. It is Prof. Jain's seminal research in pattern recognition, machine learning, and computer vision that have helped bring biometric systems into everyday use on phones and laptops, and at border control points, among many other applications.

The world-renowned biometric guru is University Distinguished Professor in the Department of Computer Science and Engineering at Michigan State University, where he has remained for over 45 years. However, during this time, his curiosity and passion for exploration have seen him journey far and wide in his achievements.

Hailing originally from Lucknow in India, Prof. Jain was schooled in the 1950s and 1960s to follow his grandfather, father, and uncles into engineering. He entered the prestigious Indian Institute of Technology at Kanpur, with an annual intake at the time of just 300 students. But with the computer age starting to unfold, rather than civil engineering, which would probably lead to a civil service job like his father, he selected a degree in electrical engineering.

Next came inspiring Master's and PhD studies at Ohio State University in the early 1970s, leading to a doctoral thesis focused on curse of dimensionality in statistical pattern recognition. While there, Professors Balakrishnan CHANDRASEKARAN and Robert MCGHEE instilled both the joys of theoretical discovery and how to apply cutting-edge results to real-world projects. In 1974, Prof. Jain joined Michigan State University.

Over the following 15 years, he deepened his expertise in pattern recognition and image processing, publishing and presenting well-received papers, and spurring interest in the area among his students. Then in the early 1990s, a fortuitous out-of-the-blue phone call from a fellow professor in Washington DC opened the way to a transformational change, for Prof. Jain and society at large.

The caller was in search of a civilian application for a newly designed piece of computer hardware for the National Security Agency: a field programmable gate array processor. After brainstorming on the machine's merits, especially its image enhancement capabilities, Prof. Jain and his research team hit on the idea of improving fingerprint recognition — images that are often blurred or of poor quality when captured.

當你下次以指尖啟動採用觸控按鍵的流動裝置時，別忘記今天獲表揚的Anil K. JAIN教授。有賴Jain教授在模式識別、機器學習及計算機視覺領域上的創新研究，生物識別系統的實際應用層面日趨擴大，至今不僅覆蓋手提電話和電腦等日常生活用品，亦延伸至出入口管制等多個範疇。

這位世界知名的生物識別技術宗師，現為美國密芝根州立大學計算機科學及工程學系「大學傑出教授」，服務該校逾45年之久。在這段悠長歲月裡，他憑著熾熱的好奇心及對未知世界的熱情探索，在多方面取得斐然成就，影響世界。

Jain教授幼年在印度北方邦首府勒克瑙度過，上世紀50至60年代，他跟隨父祖輩的步伐，接受工程教育，並成功考進每年只錄取300位新生的坎普爾印度理工學院。然而，隨著計算機時代開展，這位年青人最終選擇修讀電機工程學位而非土木工程，跳出像父親般在畢業後成為公務員的既定人生軌跡。

1970年代初，他負笈美國，於俄亥俄州立大學攻讀碩士及博士課程，並以「統計模式識別中的維數災難」為題撰寫博士論文。在其研究生生涯裡，他得蒙Balakrishnan CHANDRASEKARAN及Robert MCGHEE兩位教授教誨，兼顧理論與實踐，既享受鑽研理論之樂，亦不忘將科研成果轉化為實際應用。1974年，Jain教授加入密芝根州立大學任教。

在接下來的15年，Jain教授一面潛心鑽研模式識別及圖像處理技術，出版和發表不少備受推崇的論文，同時春風化雨，啟發學生對這門學科的興趣。1990年代初，一個來自華盛頓的意外來電，徹底改變了Jain教授的研究發展方向，甚至為社會大眾帶來劃時代的改變。

來電者是Jain教授的同儕，他正代表美國國家安全局為新設計的計算機硬件——現場可編程邏輯門陣列處理器(FPGA)拓展民用用途。Jain教授和科研人員詳細考慮硬件的優點後，認為它在改善影像質素方面有一定潛力，於是靈機一動，提議將硬件用於提升指紋識別技術，以解決當時指紋影像往往模糊不清或質素低劣的弊病。

The groundbreaking work that resulted went on to offer a complete solution to enhanced automated fingerprint recognition by combining a point-matching algorithm based on minutiae points — the major features of a fingerprint image — and a more advanced texture-matching technology, capturing the texture characteristics of a fingerprint with a set of filters. The approach, which led to six US patents, significantly boosted recognition speed and accuracy, especially for small fingerprint sensors such as those now used for our mobiles.

Such useful advances also attracted burgeoning societal interest, with fingerprint recognition evolving into one of the most widely used biometric technologies today in a sector now encompassing iris, face, voice and speech recognition systems and a global market that topped US\$25 billion in 2020.

Although Prof. Jain has chosen to follow his heart and remain in academia, over the years he has worked collaboratively with many major corporations, government agencies, and non-governmental organizations, including the Bill and Melinda Gates Foundation and UN World Food Programme which resulted in a fingerprint-based infant ID system. He has additionally greatly contributed to his country of birth, in particular through his involvement in Aadhaar, the world's largest biometric national identification system covering over 1.3 billion people.

At the same time, Prof. Jain has powered forward in academic impact, with a Google Scholar h-index of 200 and total citations topping 230,000. His list of honors and accolades is equally impressive, including a Guggenheim Fellowship (2001) and membership of the US' National Academy of Engineering (2016) and Chinese Academy of Sciences (2019).

Meanwhile, a passion for knowledge-sharing through conferences, books, and media interviews, along with a personal love of travel and a highly personable character, have taken Prof. Jain across the world as a keynote speaker, educational advisor, and visiting professor. Such overseas expeditions included HKUST, where he spent a month in the 1990s collaborating on computer vision and machine learning with the then relatively new Department of Computer Science.

Propelling forward biometric discovery and applications, making the field accessible by discussing its capabilities and limitations with diverse audiences, and serving as a mentor and friend to the field's rising-star academics and company innovators, Prof. Jain has indelibly made a difference to society overall.

Chancellor, on behalf of the Council of the Hong Kong University of Science and Technology, I have the high honor of presenting to you Prof. Anil K. Jain, University Distinguished Professor at Michigan State University, for the award of Doctor of Engineering *honoris causa*.

在取得突破性的成果後，研究團隊再接再厲，把建基於特徵點（指紋紋路在圖像上所顯示的主要特徵）的「點配對」演算法結合更為先進的「紋理配對」技術，以一系列濾波器捕捉指紋的紋理特徵，全面提高自動化指紋識別技術。研究團隊所開發的方案大大提升了識別速度和準確度，對常用於手提電話的小型指紋感應器尤其有利，相關技術已在美國取得六項專利。

這些實用的先進技術迅即吸引社會各界注意，而指紋識別亦發展成為現今應用最廣泛的生物科技之一。連同虹膜、人臉、聲音及語言識別系統，生物科技產業在2020年的全球市場總值高達250億美元。

Jain教授選擇追求個人志趣，專注於學術界發展，但無礙他與大型機構、政府部門及非政府組織合作，除夥拍比爾·梅琳達蓋茲基金會，亦曾應世界糧食計劃署邀請，研發以指模為基礎的幼童身份驗證系統。這位生於印度的科學家，對祖國同樣貢獻良多，當中尤以參與覆蓋13億人口、全球最大的Aadhaar國家級生物特徵識別系統最為人樂道。

Jain教授的學術影響力舉足輕重，其Google學術搜索h-指數及獲引文總次數分別高達200及230,000；他亦曾獲頒多項顯赫獎項與殊榮，包括古根漢獎學金(2001)、美國國家工程院院士(2016)及中國科學院院士(2019)。

Jain教授不吝於分享自己的豐富知識，除了撰寫著作，又透過會議及傳媒訪問，將科學知識公諸同好。此外，他性格外向開朗，又熱愛旅遊，多年來經常以主題講者、教育顧問及客席教授的身分外訪，足跡遍及全球。上世紀90年代，Jain教授便曾到訪科大，與當時尚處草創階段的計算機科學學系在計算機視覺及機器學習領域合作，歷時一個月。

Jain教授致力研究及拓展生物識別系統的應用，透過與各界人士討論其功能與局限之處，讓更多人認識這門科學。他不遺餘力扶掖後進，與行內新銳學者和創研企業家亦師亦友，功在社會，毋庸置疑。

大學校監，本人謹代表香港科技大學校董會，恭請閣下頒授工程學榮譽博士學位予密芝根州立大學「大學傑出教授」Anil K. JAIN教授。