

6000-citation feat by 4 Indian researchers

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IIT Kanpur the common link for Tripura-born scientist and students

New Delhi, May 10: A 13-year-old research paper that proposed a computational method to help design cars, manage financial portfolios and even select cricketers has become the first ever from India to receive 6,000-plus citations from scholars worldwide.

The paper, by engineer turned computer scientist Kalyanmoy Deb and three undergraduate students, had received 6,035 citations until this weekend — a measure of their impact and influence of their research. All four were earlier at the Indian Institute of Technology Kanpur.

"This should be a moment of celebration for Indian science," said Gopalakrishnan Mahesh, a bibliometrics research analyst at the National

Institute of Science Communication and Information Resources, New Delhi.

Mahesh has co-authored a commentary on the paper's feat in the journal *Current Science*, published by the Indian Academy of Sciences.

Among more than 50 million research papers catalogued in a global scientific database called the Web of Science Core Collection, covering the period 1945 through 2015, only 541 have over 5,000 citations. "This paper from IIT Kanpur is the first written exclusively by researchers from India to join that elite club," Mahesh said.

Published in 2002 in the journal *IEEE Transactions in Evolutionary Computation*, the paper described a strategy

to find solutions to myriad problems that involve multiple and, at times, even conflicting goals and multiple solutions of which only a few may be truly attractive.

The computational strategy the paper proposed has been picked up widely across fields for tasks ranging from engineering and drug design to financial market forecasting and portfolio optimisation for risk and return.

Medical physicists in Germany have applied the technique to plan the safest and most effective radiation dose for patients with cancer.

The Tripura-born Deb wrote the 2002 paper with mathematics undergrads Amrit Pratap and Sameer Agrawal and chemistry stu-



Kalyanmoy Deb

dent T. Meyarivan. Deb is now Koenig Endowed Chair professor of electrical and computer engineering at Michigan State University, whom he joined two years ago after teaching at IIT Kanpur for 20 years.

Four years ago, while still at IIT Kanpur, Deb and two stu-

dents — Faez Ahmed and Abhilash Jindal — used the technique to form imaginary teams on their computer, relying on the batting and bowling scores of actual cricketers.

In computer simulations, they found that 10 of their teams outplayed the Chennai Super Kings, the winner of the 2010 IPL. "I guess this work hasn't caught the eye of IPL team selectors yet, but they could really benefit through such an analysis before they choose their players," Deb told **The Telegraph**.

He added: "People can apply the technique to deal with many, many real-world problems."

Product manufacturers have to deal with this class of so-called optimisation prob-

lems while planning what to offer their consumers.

"When we go to buy a product — a car, let us say — we don't always worry about buying the one that is cheapest," Deb said. "For many consumers, there are other conflicting goals such as the comfort, looks, fuel efficiency, among other things."

The IIT Kanpur technique — known in computational science circles as the non-dominated sorting genetic algorithm-II, or NSGA-II — provides manufacturers with multiple design options for the products they can then pick to actually manufacture.

Scientists from 85 countries have cited the paper, with China, India and the US accounting for more than 2,000 of

its 6,035 citations thus far.

While the next highest-cited paper with Indian authors — dealing with physics — has 5,447 citations, it is what Mahesh calls a "mega-authorship paper" with 127 authors from 14 countries.

The second most highly cited paper among those exclusively by Indian authors is a 1995 paper by Gautam Desiraju, a professor of chemistry at the Indian Institute of Science, Bangalore, on crystal engineering. It has drawn over 2,900 citations.

The world's highest cited — with over 300,000 citations — is a 1951 paper by a US scientist that described a method to measure proteins in a liquid.

Deb studied mechanical engineering at IIT Kharagpur and worked at Engineers India for two years before doing a PhD in the US.