Intelligent Growth Maps for Indian Cities

FOR the many comforts, ease of transport, economic opportunities, and other lifestyle benefits, more and more people are choosing to migrate to cities. The UN estimates that more than 54% of the world's population, that is over 3.8 billion people, live in urban areas in 2017. This number will grow rapidly in the future.

With so many cities coming up, often government censuses, which happen once a decade, are too slow to be able to track the growth and estimate the needs of such large, concentrated populations of people. A solution to track uncontrolled urban growth or sprawl is to use satellite imagery. However, for tropical countries like India, this is not a practical solution as optical satellite imaging is blocked by clouds that are persistent in the rainy seasons. Advanced radar satellites can be used, however, it can be challenging to identify urban areas with these satellites.

Dr. Shaunak De and Dr. Avik Bhattacharya at the Microwave Remote Sensing Lab, Indian Institute of Technology Bombay have discovered a technique by which even challenging urban settlements can be correctly identified. This was done by teaching an artificial intelligence algorithm the physics of radar scattering, much like you would teach a human expert!
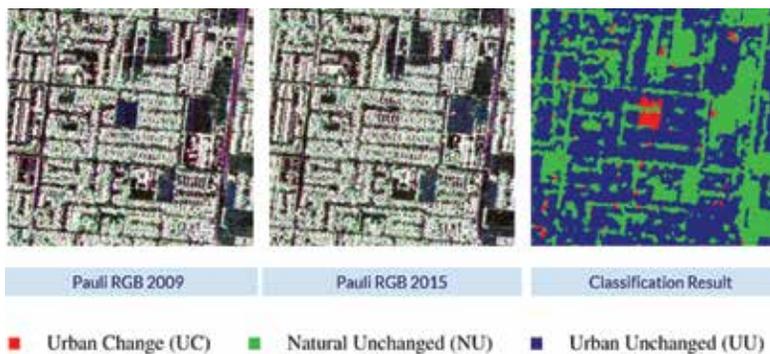
They trained an advanced machine learning technique called "Deep Learning" to understand the physics of radar scattering. To do this, they modeled various common urban buildings and observed what kind of radar scatter is obtained from them. Then they trained a machine-learning algorithm to be able to identify these targets. Much like you would teach a human to find objects, the algorithm was shown examples of different buildings in different orientations, along with examples of things that are not buildings. Slowly, it learned to identify buildings and separate them from forests and other target types.

The novel algorithm has extracted human analyst-like performance in identification of urban areas and detection of changes in urban areas. This is very useful for monitoring sprawl in cities, construction, destruction of urban areas, etc. Using this algorithm it is possible to quickly identify damaged urban areas in cases of natural disasters like floods and hurricanes where traditional satellite imagery would be futile because of the cloud cover.

With upcoming spacecraft like the joint NASA-ISRO NISAR satellite, which will gather enormous amounts of radar data of Earth's surface, such techniques are of paramount importance. It will be impossible to manually search through all that data. Thus, advanced artificial algorithm techniques can help quickly scan through the data, and identify urban areas and map them. Armed with growth maps urban planners can then help make better policy and governance decisions. In case of a disaster in the urban area, they can also come up with rapid mitigation strategies.

The researchers have published their findings in various journals including *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* (2017).


Pauli RGB 2009   Pauli RGB 2015   Classification Result

■ Urban Change (UC)   ■ Natural Unchanged (NU)   ■ Urban Unchanged (UU)

Augmented Video Games can Help in Stroke Recovery

VIDEO games, popular among kids in the 1990s, have made a comeback with the advent of Virtual Reality (VR) which gives users a sense of touch when augmented with add-on instruments. A group of Indian engineers and neuroscientists has put these advances to use in a field which is not entertainment – recovery of stroke patients.

The technique developed by a group of researchers at the Indian Institute of Technology, Gandhinagar, is a computer-based exercise platform augmented with a feeling of touch. It is a performance-sensitive platform that can intelligently adapt itself as per the performance of patients.

The software of the platform consists of 48 templates of VR-based 'reaching' and 'coordination' tasks that trigger abduction and adduction movements of the shoulder joints as prescribed in physiotherapy guidelines. These tasks in the video game have three difficulty levels to suit the severity of stroke. The hardware interface consists of a haptic stylus that provides tactile feedback to users. In addition, the platform has modules for task switching and physiological data acquisition.

(a)
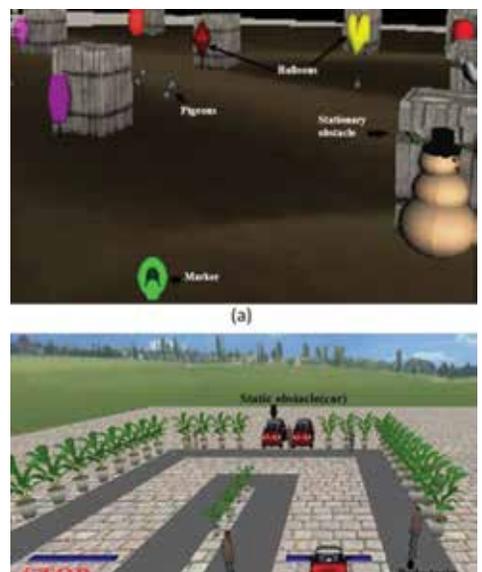
The video game tasks appear to be similar to what kids play but they have been designed for a specific purpose for stroke patients. For instance, the car navigation task requires users to tackle dynamic obstacles like a pedestrian crossing the road as well as static obstacles like tree pots at the edge of the road. This is a coordination task, designed for abduction movement of the shoulder joint. Similarly, 'reaching' task where participants have to puncture balloons, avoiding dynamic and static obstacles, is supposed to spur adduction movement. The technique has been tested in a set of six patients with chronic stroke and has been found to be effective. The research results have been published in *Computer Animation and Virtual Worlds*.

"Unilateral shoulder abduction and adduction are essential for performing daily activities. In our experimental setup, while stroke patients interacted with our VR-based tasks, we recorded their physiological signals in a synchronised manner. Results indicate the potential of using this adaptive and individualised system in persons who had a stroke suffering from upper limb movement disorders," explained Dr. Uttama Lahiri of IIT Gandhinagar, who led the team, while speaking to *India Science Wire*.

The researchers said the system can deliver real-time feedback on one's skill progress. The patients in the study interacted with the system for 30 minutes a day for a week. Results indicated that their performance improved in terms of better scores, reduced task completion time and reduced performance errors.

"Computer game-assisted upper limb recovery seems to be a novel method for assisting recovery of brain functions after stroke. Such game-based recovery may help in precise motor unit activation which makes recovery rational and task-oriented," commented Dr. Vijaya Nath Mishra, a stroke specialist at the Sir Sunderlal Hospital, Banaras Hindu University, who is not connected with the study. However, he said, cost and affordability factors would have to be addressed for the new system to become a useful intervention.

Dinesh C. Sharma, *India Science Wire*

Marketing Dropped Aonla Fruits

EVERY morning in our Aonla orchard, we find the ground under Aonla tree canopy layered by several small-sized Aonla fruits. Can these tiny marbles fetch a good price in the market?

Aonla is also known as Indian Gooseberry and its scientific name is *Emblica officinalis*. It has a high medicinal value. The fruits are the richest source of vitamin C (700mg/100gm of fruits). Aonla fruit having sour and astringent taste is generally utilised raw, cooked or in the form of pickle. Preserves, juice, jam, cheese, candy, powder, beverage, laddoo, burfee, chutney are the different types of aonla products available in the market.

Ayurvedic medicines like Chyavanprash, Triphala churna, Brahma rasayan and Madhumegha churna contain Aonla as an essential ingredient. The fruit is valued as an antiscorbutic, diuretic, laxative, antibiotic and antidysenteric too. Phyllemblin, obtained from the fruit pulp, has been found to have a mild depressant action on the central nervous system. It has very good demand in industries for the preparation of various health-care products also like hair oils, dye, shampoo, face creams and tooth powders.

Aonla if collected at different stages at regular intervals and stored separately

Dried Aonla fruits

can be marketed. The dropped fruits can be collected right from the pea stage. The undamaged fruits are collected in gunny bags, dried under the sun and powdered. The fruits upto one and the half month after fruit set can be ground directly after drying as they have very soft seed. In later stages, the fruits are deseeded for powder preparation.

The powder obtained from the initial stages upto three months is dark in colour and smooth in texture.

This dark colour is due to the presence of high phenolic compounds (140-150mg/100g) – these fruits are low in ascorbic acid (150-160mg/100g). These phenolic compounds are the major constituents of cosmetic products like shampoo, conditioners, disinfectants, food and health products, resins, etc. They can be marketed separately to industries.

The fruits obtained during the later stages i.e. after three months till the final harvest stage, are fibrous, rich in ascorbic acid (580-590mg/100g) and low in phenols (25-30mg/100g). These fruits can be collected, cleaned, deseeded, powdered and marketed. The fruit powder can be used in several edible products like chyavanprash, triphala churna, Ayurvedic health tonics, etc. The fruits fetch premium prices as that of the mature fruit powder.

Farmers can benefit by the adoption of this technique of marketing the dropped Aonla fruits at different stages of growth with higher benefits.

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Amazing Ants

A report published in this years' April issue of the journal *ZooKeys* described a new "exploding ant" that practices 'autothysis' (meaning self-sacrifice in Greek). The ant is *Colobopsis explodensis* and is a native of Borneo. It lives in large colonies inhabiting the leafy canopies of giant trees of the region. The ant attacks its foes by deliberately rupturing its own abdomen to release a yellow sticky concoction of toxic substances.

Interestingly the 'ant bomb' squad is exclusively female. In addition, a fraction of members of the female squad has characteristically enlarged heads that function like perfect plugs to block the entrance of their nests during attacks by predators.

Another ant, *Sericomyrmex amabilis*, a native of Central America, strangely but very strategically, hosts a parasite *Megalomyrmex symmetochus*, also an ant, in its colony and permits it to feed not only on the fungi cultivated in the ant colony but also on their own larvae. The parasite remains unopposed in the colony, at times for years, enjoying the generous hospitality. The reason for this apparent timid surrender by the hosts has been studied by authors of the article published in the *Journal of Animal Behavior* in May 2018 issue.

The parasitic *M. symmetochus* produces an alkaloid venom that scares off dangerous invaders. The parasite, in return for its occasional military support, gains 'free place to crash, free meals and a sort of ant-diplomatic immunity'.

In another study published in the February 2018 issue of the journal *PlosOne*, researchers from IISER Kolkata, showed that brood theft is common in the Indian queen-less ants *(Diacamma indicum)* and is routinely practiced to augment their work-force. The study suggests that each colony has a small population of 'professional thieves', who would engage themselves repeatedly in stealing mainly pupae

The exploding ants (in dark red) attack an enemy ant. Credit: Alexey Kopchinskiy

in large numbers from neighbouring colonies, The colonies they invade are not always defenseless and the ant-thieves have to at times face severe "antennal boxing" and biting by the hosts. For this reason, the ant thieves need to act fast and prefer to target unattended pupae.

North Carolina University in their study published in a recent issue of *Royal Society Open Science*, showed that some ant species produce powerful antibiotics that they rub on their body surfaces to escape infections. The finding is particularly attractive in that the antimicrobials have the potential to emerge as alternative therapeutics in the fight against pathogens that are turning resistant to all known antibiotics. Among the ant species investigated, the desert fire ant, a forager, produced powerful antimicrobial substances. Not all ant species studied were however similarly effective in this regard.

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New Pathway Kills Ovarian Cancer Cells Selectively

OVARIAN cancer is the most lethal among all gynaecological malignancies and is plagued by very poor therapeutic options. The current therapeutic strategy relies on surgical removal of the tumour followed by chemotherapy using platinum and taxol-based drugs. Although effective early on, drug resistance and tumour remission are major issues leading to a very poor overall five-year survival rate for this disease.

Scientists at Baylor College of Medicine and the University of Texas MD Anderson Cancer Center at Houston, USA have discovered a new way to target ovarian cancer cells carrying specific mutations. This discovery published on 28 March 2018 in the journal *Nature Communications* has the potential to revolutionise extant therapeutic approaches and pave the way towards the development of personalised treatment options for ovarian cancer and potentially other cancers as well.

Mutations in the tumour suppressor gene called p53 are the most common genetic alteration in ovarian cancer. As much as 96% of high-grade serous ovarian cancer (the most common and lethal ovarian cancer sub-type) cases have been shown to have mutations in p53. While some of these mutations result in loss of the tumour suppressor function of p53 (which is bad), many result in gain of new oncogenic (or

New Immunosuppressive Therapy in Kidney Transplantation

IN a study jointly conducted by researchers from the US (Cedars-Sinai Medical Center, Los Angeles), Sweden (Uppsala University, Uppsala; Karolinska Institutet and Karolinska University Hospital, Stockholm) and the UK (Oxford University, Oxford), a new form of immunosuppressive therapy (treatment that suppresses or inhibits the immune system) has the potential to overcome rejection of grafts in kidney transplantation (i.e., the transferring of an organ or graft from one man to another).

The study was published in the *New England Journal of Medicine* (2017; 377:442-53).

The new therapy is IdeS (IgG-degrading enzyme derived from *Streptococcus pyogenes*, a bacterium). IgG is a class of immunoglobulin or antibody or molecule which is produced in response to an antigen or foreign substance. IdeS breaks down human IgG thus preventing the toxicity caused by IgG resulting in immunosuppression.
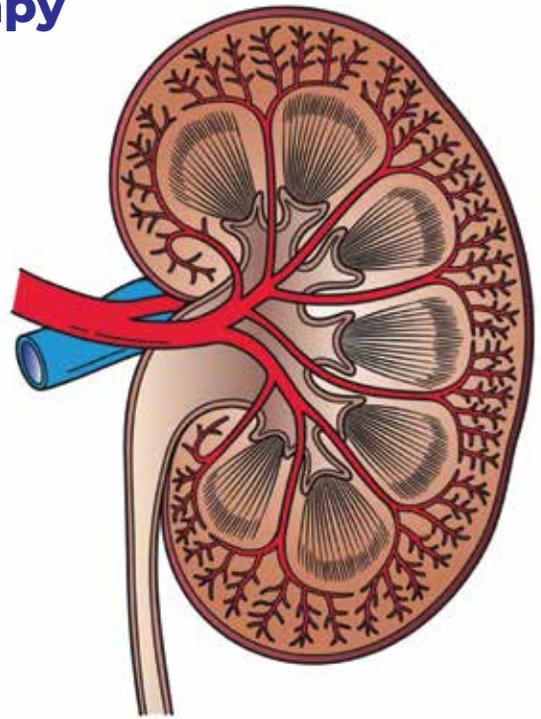
IdeS was administered to 25 highly HLA-sensitised patients prior to kidney transplantation from an HLA-incompatible donor. HLA stands for Human Leucocyte Antigen, which is responsible for tissue rejection; HLA-sensitisation means that the person has been exposed to that particular HLA and is reactive to it. The patients received IdeS over 15 minutes, about 4–6 hours prior to transplantation.

There was a significant reduction in the levels of IgG HLA antibodies. Reduction or elimination of donor-specific antibodies after treatment with IdeS resulted in successful transplantation in 24 out of 25 patients.

The strengths of the study were consistent elimination of donor-specific antibodies to a level that allows kidney transplantation from an HLA-incompatible donor (for transplantation to be successful, the donor and recipient have to have matching HLA; in case there is a mismatch, it is termed as HLA incompatible), while the major limitations of the study were the small number of patients recruited and the varying protocols in the centres involved in the study.

This is a major advancement in the desensitisation process which could pave the way for successful kidney transplantation and prevent rejection of the graft. Larger multicentre trials are needed in view of the encouraging results of this study.

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cancer-promoting) function. These oncogenic p53 mutations accumulate in cells and drive cancer progression and drug resistance.

We have shown that if you deplete these p53 oncogenic mutants in cancer cells, we can kill cancer cells. But how do you achieve depletion of the oncogenic mutant p53 protein present in the cancer cells without affecting the normal p53 (which is tumour suppressive) present in healthy cells in the body? Till date, no protein or cellular pathway was known which would selectively regulate any of the p53 oncogenic mutants specifically without impacting normal p53.

In our paper, we overcame this limitation in our understanding and identified a deubiquitinase called USP15 as the first known selective regulator of the p53-R175H mutant, a p53 oncogenic mutant that is seen frequently in many human cancers including ovarian cancer. Depleting USP15 levels or activity, leads to decreased levels of p53-R175H mutant in cancer cells (but not normal p53 levels), which in turn causes specific killing of cancer cells carrying this mutation. Thus, by targeting USP15 we can selectively achieve killing of cancer cells that have the p53-R175H mutation.

USP15 being an enzyme, is amenable to the rational design of drugs that can block its function, thereby opening up new avenues to treat ovarian cancer based on the p53 mutation status of the patient's tumour, or in other words a personalised targeted therapeutic approach.

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