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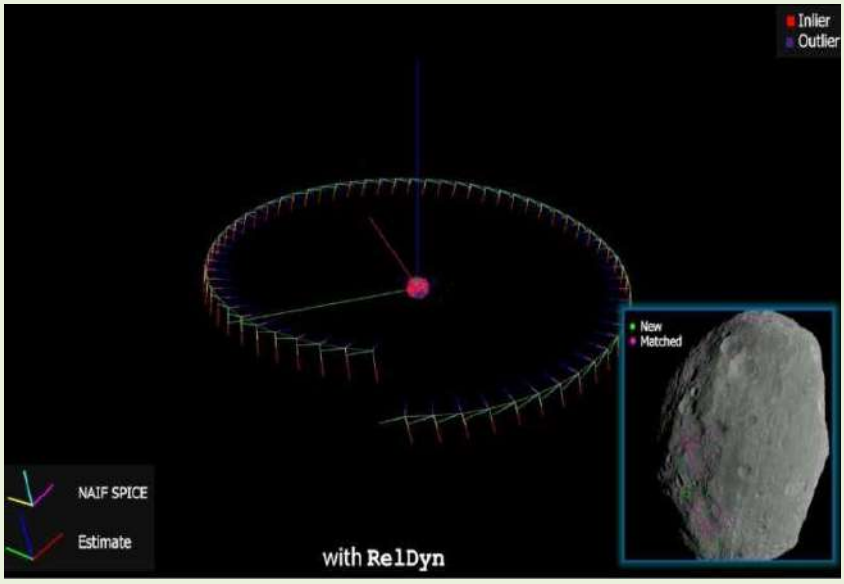
Contents

LATEST UPDATES WORLD

A model to enable the autonomous navigation of spacecraft during deep-space missions

Before a machine-learning model can complete a task, such as identifying cancer in medical images, the model must be trained. Training image classification models typically involves showing the model millions of example images gathered into a massive dataset.



Simultaneous localization and mapping (SLAM) is a promising technology that can be used to improve the navigation of autonomous systems, helping them to map their surrounding environment and track other objects within it. So far, it has primarily been applied to terrestrial vehicles and mobile robots, yet it could also potentially be expanded to spacecraft.

Researchers at Georgia Institute of Technology (Georgia Tech) and the NASA Goddard Space Flight Center recently created AstroSLAM, a SLAM-based algorithm that could allow spacecraft to navigate more autonomously. The new solution, introduced in a paper pre-published on arXiv, could be particularly useful in instances where space systems are navigating around a small celestial body, such as an asteroid.

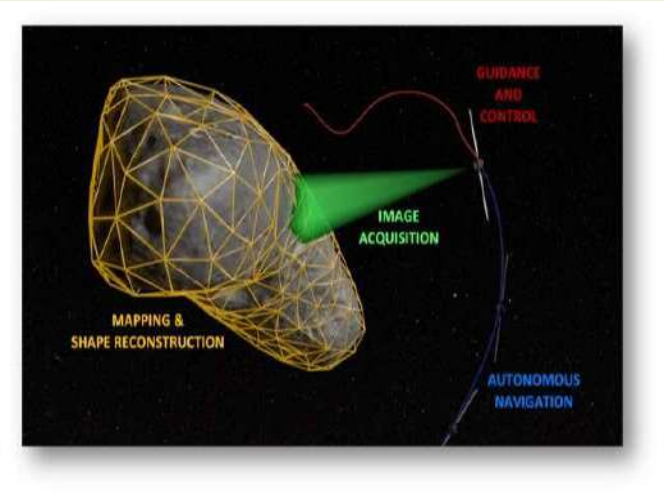
"Our recent work is part of a NASA-funded ESI (Early-Stage Innovations) program whose objective was to make future spacecraft destined for deep-space missions (e.g., visiting and surveying asteroids) more autonomous," Panagiotis Tsiotras, one of the researchers who carried out the study, told TechXplore.

"This problem is of great interest since, owing to the large distances from Earth, it is difficult to execute the required maneuvers around the asteroid in a real-time manner. Instead, the current process requires a large team of human operators on the ground to downlink the images captured from the spacecraft and to analyze them offline to create digital terrain maps, which amounts to carefully choreographing the spacecraft maneuvers."

Ensuring that spacecraft move in desired ways around asteroids is a laborious, tedious and time-consuming task for human agents on Earth. A model that can autonomously reconstruct the shape of nearby asteroids and navigate the spacecraft with minimal intervention from Earth would thus be incredibly valuable, as it could facilitate and potentially speed up deep-space missions.

AstroSLAM, the solution developed by Tsiotras and his colleagues, can autonomously generate the location and orientation of spacecraft relative to that of nearby asteroids or other small celestial bodies. It achieves this by analyzing a sequence of images taken from a camera onboard the spacecraft as it is orbiting the celestial body of interest.

"AstroSLAM, as its name suggests, is based on SLAM, a methodology that has so far been used with great success in terrestrial mobile robots, but which we not extended to the space environment," Tsiotras explained. "Our model can also generate a 3D shape representation of small celestial bodies and estimate their size and gravitational parameters. The algorithm is the culmination of more than five years of work in vision-based relative navigation for spacecraft in my group, the Dynamics and Control Systems Laboratory at Georgia Tech."



Autonomous operations in the vicinity of a celestial small body. Credit: Dor et al.

AstroSLAM can estimate the relative position and orientation of spacecraft in full autonomy. This information can then be used to plan and execute various maneuvers in orbit, including landing on a nearby celestial body. The model can also generate images of the 3D shape of the nearby celestial body, estimating its size and gravitational parameters.

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"One of the novelties of AstroSLAM is that it takes into account the motion constraints stemming from the orbital dynamics, thus providing a much more accurate navigation solution," Tsiotras said.

"AstroSLAM reduces a spacecraft's reliance on the human ground crew to run complex computations, thus increasing its autonomy and relative navigation capabilities. Even if we continue to rely on existing well-tested methodologies for the foreseeable future, the proposed approach can also serve as a 'back-up' solution in case the primary approach fails, as it relies on just a single camera."

The researchers evaluated their technology in a series of tests, using real data captured by NASA during legacy space missions and high-fidelity artificial data generated using a spacecraft simulator at Georgia Tech. Their findings were very promising, suggesting that AstroSLAM could eventually enable the autonomous operation of spacecraft in various scenarios.

"We are currently working on improving the image processing step of AstroSLAM (e.g., salient feature detection and tracking), by leveraging a state-of-the-art neural-network architecture trained on a large database of real images of asteroids from prior NASA missions to detect more reliable, salient surface features," Tsiotras added. "Once integrated with AstroSLAM, this work is expected to increase the reliability and robustness against incorrect measurements (outliers) and difficult illumination conditions."

Tsiotras and his colleagues are now also working to allow the model to merge images from visible light and infrared light, to attain even better performances. Finally, they wish to extend their approach to operational scenarios in which the images would be captured by multiple spacecraft in orbit concurrently.
"Small celestial bodies, such as asteroids, comets, and planetary moons, are fascinating and scientifically-valuable targets for exploration," said Kenneth Getzandanner, co-author of the paper and flight dynamics lead for Space Science Mission Operations at the NASA Goddard Space Flight Center.

"Missions to these objects, however, present unique challenges to navigation and operations given the object's small size and the magnitude of perturbing forces relative to gravity. Recent small body missions, including the Origins, Spectral Interpretation, Resource Identification—Security Regolith Explorer (OSIRIS-REx) at the near-Earth asteroid 101955 Bennu, exemplify these challenges and require extensive characterization campaigns and significant ground-in-the-loop interaction. Technologies such as AstroSLAM are useful for simplifying operations, reducing reliance on ground assets and personnel for near real-time operations, and enabling more ambitious mission concepts and near-surface sorties."

DEPARTMENT ACTIVITY

- **Zero Hour Activity (Cricket Match)**
  1st December-2022

Venue: SRMSCET Main Ground

On 1st December 2022, the MCA department organized a Cricket Match in the club activity hour. In which Mr. Vijay Kumar Dubey was present to motivate students.
This game was held between two teams:

Team 1- Aditya Sarswat, Manthan Gupta, Ritik Kumar Saxena, Yashi, Prashant Rajpoot, Gyanendra, Mansi Prajapati, Vishal kashyap and Saurabh Tiwari

Team-2: Vishal Sharma, Pradeep Kumar, Sanskriti Gupta, Yashika, Pankaj Kumar, Rahul Kuniyal, Mohit Kumar, Nikhil Kumar, Abhishek Maheshwari

All the players were holding a good time and giving their best performance but Team-1won the match.

➢ Fresher's Party of MCA, Batch-2022 (10/12/2022)

Venue: MBA Seminar Hall, SRMSCET

The more we feel concern for others and seek their well-being, the more friends we will have and the more welcome we will feel". With this thought we welcomed our energetic and enthusiastic juniors on 10th December, 2022.

It was a memorable day in the life of every fresher of MCA Batch 2022 at SRMSCET, Bareilly. The fresher's day was filled with excitement, joy, music, enthusiasm, laughter and happiness.

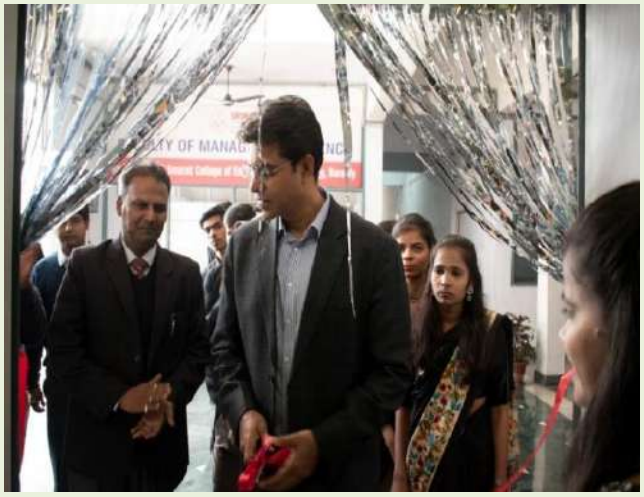
The epoch initiated by inaugural ceremony. The ceremony started with the welcome of guests Shri Aditya Murti, Secretary, SRMS Trust, Er. Subhash Mehra, Trust Advisor, Dr. Prabhakar Gupta, Dean Academics followed by the auspicious lamp lightening ceremony and prayers of Maa Saraswati.

Shri Adiya Murti ji congratulated all the fresher's for joining MCA course in SRMSCET, He said fresher party is very important event as it establishes emotional bond among students. He also mentioned that juniors must learn to establish a bond of faith and trust with their seniors and apart from that he emphasized on learning new technologies and improving coding skills for the better development and for grabbing better job opportunities.

The celebration was taken forward to next step with the cake cutting ceremony, after that each and every fresher introduced themselves in to all the dignitaries, faculty members and their seniors, followed by their individual performance.

Last but not the least the main attraction of party was prize distribution ceremony were the result was declared as:

- Mr. Fresher – Rahul Kuniyal
- Miss. Fresher –Priyanshi Agarwal
- Mr. Talent – Manthan Gupta
- Miss Talent –Yashi




Start


Start


Mr Fresher

➢ Zero hour activity (Antakshari)
22nd December-2022

Venue: MCA Seminar Hall

On 22nd December 2022, the MCA department organized an Antakshari in the zero hour activity hour. In which Dr. Sanjay Kumar, Dr. Jyotirmay Patel, Mr. Arvind Mishra and Mr. Vijay Kumar Dubey were present to motivate students.
This Antakshari was held between two teams:

Team 1- MCA 1st year
Team-2: MCA 2nd year

All the team members were holding a good time and giving their best performance but Team-1(MCA 1st year) won the Antakshari.

➢ Placement of MCA Final Year Student (Batch-2021)

SRMSCET, Bareilly congratulates MCA Final year student Ms. Anchal Singh for her placement with Airdit Software Services Private Ltd at the CTC of Rs 3.50 LPA.

➢ Research Challenges in Cloud Computing

Cloud computing consists of applications, platforms and infrastructure. Each aspect performs its task and produces the desired results for business and personal tasks. Business applications consist of SaaS, PaaS, IaaS, web services, service providers, utility computing and service commerce.

As cloud computing deals with integrated technologies, many systems are involved, including networking, database management, operating systems, virtualization, resource scheduling, transactional control, concurrency control, load balancing and memory management. Security issues apply to all these systems, and security systems need to be maintained in a cloud computing environment. Many security challenges have been addressed and solutions have been implemented, including data encryption. However, a number of challenges remain for research in this field:

1. Service-Level Agreement (SLA)

The cloud needs to be administered by an SLA, which covers issues like data protection, cost and outages. Customers also expect the SLA to provide back-up and data archiving and protection. The SLA allows many instances of an application to be copied onto multiple machines, according to a priority system. A major challenge for cloud customers is to calculate the SLAs of cloud vendors.

2. Data Management

The amount of data in the cloud is enormous; it may be in structured or unstructured form. Service providers have to rely on infrastructure providers for data security as they do not have access to the physical security system. The infrastructure provider has to achieve confidentiality and auditability for security. Confidentiality of data means the data must be accessed and transferred securely by applying cryptographic protocols. Auditability involves the use of remote attestation protocols to ensure security applications are not tampered with.

3. Data Encryption

The main technology for ensuring data security is encryption. Before uploading a file to the cloud, data needs to be encrypted to protect it from unauthorized access.

4. Migration of Virtual Machines

Many programs run on a machine using virtualization, or one program is run on more than one machine. Virtualization can be used in cloud computing to balance load in the data centre. The advantage of virtual machine migration is to avoid hotspots.

5. Interoperability

Interoperability means the ability to work for more than two systems so that information can be exchanged. Some public cloud networks are designed in such a way that they are not able to interact with one another. This design fault prevents organizations from combining their IT systems in the cloud to improve cost and efficiency. To overcome this challenge, the standards of the organizations must be improved so that cloud service providers can design interoperable platforms to enable data portability.

6. Bandwidth Cost

High-speed communication channels are important for the efficient operation of cloud computing. Efficient hardware and software can be developed to save on costs, but bandwidth is expensive. The front input cost can still be reduced by migrating data to the cloud, but the network cost is increased. A major issue arises if data is consumers' private data and if it is distributed to various clouds. Data-intensive jobs must therefore only be undertaken on private clouds.

7. Virtualization

Virtualization is the creation of a virtual version of the storage devices, operating system, multiple servers or networks, enabling the

customers to migrate their data to a remote destination. It divides tasks between multiple environments, and data abstraction of resources is carried out to simplify the system. There are two types: base metal virtualization (Type 1 hypervisors) and operating system virtualization (Type 2 hypervisors). Virtualization provides elasticity, scalability, independence of location, cost-effectiveness and a simple interface. But the challenges are workload, security, unnecessary migration, automation and on-demand elasticity.

8. Energy Consumption

Cloud data centers which set up the infrastructure contain many servers. These servers consume a lot of energy, are very expensive to operate and generate excess heat which needs to be removed. The ultimate goal is not only to reduce energy consumption but also to maintain environmental standards.

9. Management And Scheduling of Resources

Management of resources can be done at various levels – hardware, software and virtualization – to verify parameters like performance, security, management of memory space, CPU, threads and device controllers. Job scheduling is an aspect of resource provisioning which aims to optimize the turnaround time, arrival time, burst time, waiting time, throughput, response ratio and utilization of resources. Cloud computing comprises many technologies to which job scheduling strategies can be applied. Scheduling of jobs is an important process. Incorrect scheduling may have serious consequences and lead to wastage of resources.

10. Reliability And Availability

The strength of technology can be measured in terms of the degree of its reliability and availability. Reliability means how often the resources are available without disruption. To achieve a reliable system, resource utilization must be performed. Availability means that resources can be obtained at any time when needed. However, even a reliable and available system may be subject to service denial, slow performance or natural disasters.

11. Scalability And Elasticity

The two main features of cloud computing are scalability and elasticity. The users of these features make unlimited use of these services according to their needs. Scalability is the ability of the system to perform well, even if the resources are scaled up or down. Elasticity is the ability to scale the resources up or down when required. Elasticity allows the static integration and extraction of the resources in the infrastructure. Scalability can be horizontal or vertical: horizontal scalability means adding more nodes in the form of new machines to existing systems, or the addition of memory or processors to an existing computer.

12. Accessibility of Servers And Applications

Traditionally administrative access to servers was controlled and restricted to direct or on-premise connections. But in cloud computing, administrative access is through the internet, which increases risk. Administrative access is important for maintaining changes in system control. Accessing data is mainly related to the security concerns which the user faces in accessing the data. Security policies may need consideration where individuals are not given access to certain data. To avoid data intrusion by unauthorized users, these security policies need to be followed.

13. Data Integrity

Data integrity means that the contents of the data should not be tampered with. Corruption of data can occur at any time during storage and at all levels. Transaction control protocols such as ACID (atomicity, consistency, isolation, durability) are used to ensure the integrity of data.

14. Data Availability

If the cloud depends on a single service provider, it may suffer from data unavailability in the case of system failure. A multi-tier architecture involving several servers is therefore required.

Even if one system is unable to provide the available data, others are still available to service the cloud.

15. Data Segregation

Data present in the cloud is in a shared environment. Encryption of data may not be the only solution, as encryption techniques may destroy the data. If encryption is done, it should be carried out at different levels by experienced personnel.

16. Protection of Data Storage

Protection of data is one of the significant security issues in cloud computing. The best and most secure technique is cryptographic encryption followed by self-shipping of the key of the encrypted hard drive.

17. Patch Management

The self-servicing nature of cloud computing may make patch management difficult. If an enterprise subscribes to a resource, the patch management for that enterprise will become the responsibility of the subscriber. Cloud computing systems should therefore maintain the patch resources supplied by the vendor.

18. Security Policy And Compliance

Service providers are required to adhere to audits (such as ISO standards) and security certification. If these standards are not maintained, customer trust in security will be adversely affected. The organization implementing the audit must check and continue to monitor contractual, legal and policy requirements.

(Compiled by: Dr. Jyotirmay Patel)
MCA Department