



Objectives and activities

The main objective of AMM is to contribute to Mechanical Design at all levels starting from academic research to industrial initiatives, thereby enhancing the quality and reliability of indigenous machines.

With this in view, AMM organizes the International and National Conference on Machines and Mechanisms, iNaCoMM, and International Conference on Industrial Problems on Machines and Mechanisms, IPRoMM regularly.

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Message from the President

It is a great honor to address you through the AMM News Bulletin as we continue our journey of innovation and excellence in the field of mechanisms and machines. Our association has long been at the forefront of advancements, fostering collaboration between academia, industry, and researchers to push the boundaries of engineering and technology.

In today's rapidly evolving world, the role of machines has expanded beyond traditional mechanical systems. The integration of artificial intelligence, automation and advanced control systems have redefined how we approach design, manufacturing, and even everyday tasks. These developments reshape industries and create new opportunities for enhancing efficiency, productivity, and sustainability.

At AMM, we remain committed to promote knowledge exchange, supporting cutting-edge research, and building a community of professionals passionate about shaping the future of machines and mechanisms. I urge all researchers to actively participate in our events, share insights, and contribute to the growth of this dynamic field. Your involvement is crucial to our collective success.

We regularly conduct iNaCoMM and IPRoMM series of conferences held in alternate years. AMM represents India in IFToMM, and numerous AMM members have engaged in various IFToMM events. Special issues of the IFToMM-supported journal, Mechanism and Machine Theory, have been published, only featuring papers presented at iNaCoMM, with the volumes specifically edited by the iNaCoMM organizers. AMM offers partial assistance to young researchers participating in IFToMM events. AMM has garnered support from a majority of academic institutions, research institutes, and industrial organizations nationwide over the years. AMM has expanded its scope to include emerging fields such as Robotics and Automation. It is imperative to expand the base to incorporate a greater number of young researchers. I am confident that we would all meet the challenge.

As we look into the future, let us continue working together to harness the power of innovation. In order to foster this aspect, three societies, namely, AMM, The Robotics Society (TRS) and Indian Society of Mechanical Engineers (ISME), have jointly agreed to closely interact and help each other. Our collective efforts are not just about progress but about creating transformative solutions for the challenges ahead. Thank you for being an integral part of this vibrant community.



Prof. S. K. Saha
President, AMM

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About Association of Machines and Mechanisms (AMM)



Association for Machines and Mechanisms (India)

Society Registration Number: DRB4/SOR/166/2020-2021

Member Organization of IFToMM (International Federation for the Promotion of Mechanism and Machine Science)

The registered address of AMM is the Department of Mechanical Engineering, IISc Bangalore and its Office Bearers are academicians and researchers from institutes spread across the country. AMM invites both individual and corporate membership from Indian academia, research organizations and industry. Membership benefits and other information about AMM are available at www.ammindia.org. The editorial team of this news bulletin attempts to bring out contemporary developments in the area and recent events regularly. We invite contributory articles from its members and others working in the various fields of mechanisms and science for this news bulletin. Interested people can contact the editorial team.

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Looking into the Past to Find Solutions for the Problems of the Future

Author: Prof. Sandipan Bandyopadhyay, Indian Institute of Technology Madras

Just as in life, in research, too, it is quite natural to focus on the future to move forward. We try to predict it, estimate its demands, and prepare for those. We have learnt to do so from our practical experiences to propel any technology to a mature stage where it is usable in a safe and extensive manner. It often takes decades of preparation and planning. We have been working on cold fusion and quantum computing for so many years, for example, and yet, we may need to wait for some more to see them being adopted widely.

It is interesting, however, to note that this “lookup” process need not always be monotonic – there are times, when in order to proceed, we need to look back – to draw knowledge and inspiration from the past. While this could be true in many branches of science and engineering, in this short note, I shall relate to two first-hand and recent experiences, wherein while trying to solve open problems in modern robotics, one had to go back a century in one case, and a couple of millennia in the other!

As a doctoral student of Mechanical Engineering at the Indian Institute of Science, I was inspired by the thesis of my senior, Prof. Bhaskar Dasgupta, who had made significant forays into the most formidable of spatial mechanisms: the Stewart platform manipulator (SPM)¹. Towards the end of the thesis, he added something very valuable – a list of open problems, which provided a handy list of targets for the next set of researchers. I picked up one of those for myself: the analytical derivation of the singularity surface of this manipulator and thus started a personal battle with this manipulator which rages on even after a couple of decades. I did, however, meet with some success in deriving the equation of the surface for a class of SPMs, and also managed to prove the following: for a constant orientation of the moving platform, the singularity surface is such a cubic that each plane parallel to the fixed platform cuts it in a hyperbola, except in at the most five cases! In either zero, two or four of them, the hyperbola degenerated to a pair of straight lines, while in exactly one of them, it transformed to a parabola. All of these could be proven analytically, but the reasons behind these remained elusive. Why should there be only two or four points of degeneracy? Why only one parabola? In the publication [1] that reported these results in 2006, we could only raise these questions, without even making an attempt to answer them from either a mathematical or a physical perspective. In the next few years, the article did receive some views and citations, but none of the papers following up on it explained the significance of those special cases.

Finally, the answer came up in 2015. It was pretty fast, considering the typical tenure of open questions of mathematical nature. Prof. Miche Coste published a paper along with Prof. Seydou Moussa [2], which presented a detailed explanation of the observations we made in 2006. The most interesting point, however, was that this explanation was based on a treatise written by one of the legends of “modern” mathematics – Arthur Cayley (1821-95), who may be familiar to most of us because of his famous theorem which bears the name of another legend – Sir William Rowan Hamilton. In “A memoir on cubic surfaces”, published in 1869, Cayley established that there can lie 27 lines on a cubic surface, and characterised them in painstaking detail [3]. As it turns out, the pair or quartet of lines that were found to lie on the singularity surface mentioned before, belonged to this system of lines, documented more than a century prior to their identification!

It took Prof. Coste’s profound knowledge of the past developments to connect these dots, which appeared

¹ Let us skip the clichéd debate on the nomenclature – whether it should be called the Gough-Stewart or Stewart-Gough or Gough platform instead – and leave it for the investigation of those curious about the same.

in an asynchronous manner: The SPM itself surfaced in 1965, Dasgupta’s thesis in 1997, the singularity surface in 2006, while the characterisation of the surface happened in 2015, referring back to the treatise written in 1869, many years before the birth of the platform itself and all the researchers mentioned above!

At this point, we must answer the “So what?” question, since it is only natural to be curious about the engineering relevance of the above chain of developments, especially the last one. Those familiar with analytical methods of path- planning may readily appreciate the significance of such characterisations, as these determine the topological properties of the singularity surface. Research is already underway to take advantage of this knowledge; interested readers can find some details on this in a recent publication [4].

The second example is more recent. While it pertains to the same manipulator, the context this time is that of design of the same. The SPM has spherical joints, similar to the ball-and-socket joints that connect our legs to the hip. Naturally, these joints impose certain restrictions on the motions of the legs of the SPM, just as our legs experience analogous constraints on their rotations at the hip joint. An important question associated with the design of the SPM is that of determining the specifications of the spherical joints for a desired range of motion of the moving platform in space. One way to solve this problem reduces it to a problem in computational geometry², which is to find the smallest (right-circular) cone, that encapsulates a finite collection of cones sharing the same vertex (Fig. 1). Interestingly, this problem has neither been solved, nor even been mentioned in any source that my doctoral student Bibekananda Patra and I could lay our hands on! Thus, in order to proceed any further, we had to find a solution to this ourselves. It is during this process, that we found that this problem requires (at least in our formulation) the solution of an underlying geometric problem, whose “cousins” predate Jesus Christ himself! The problem we had at our hands was that of finding the circles which are tangent to three given circles on a sphere [5]. As it turns out, Apollonius of Perga (c. 240-190 BC) solved the planar version of this problem [6] and a few related ones more than two millennia ago, leading to eight distinct circles, at the most (Fig. 2)!

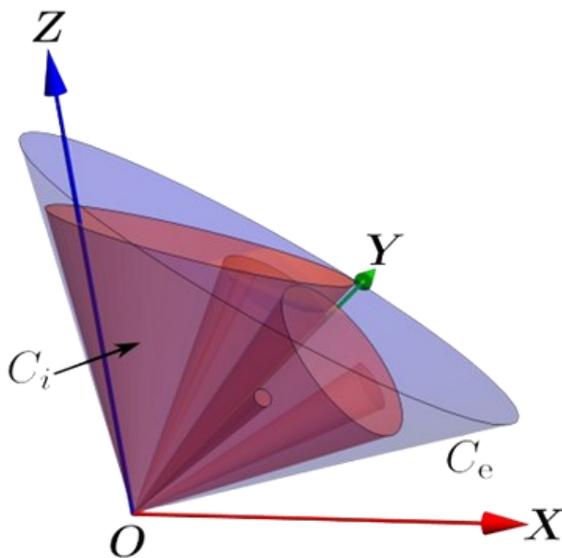


Figure 1: Minimum enclosing cone of multiple cones sharing same vertex (taken from [5])

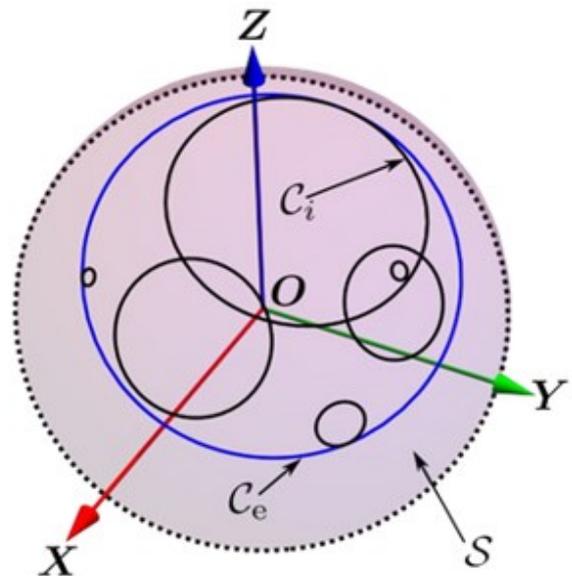


Figure 2: Minimum enclosing circle of three circles on the sphere S (taken from [5])

Finding these circles also solves the problem of determining the smallest circle enclosing three given circles. Since then, mathematicians have generalised these problems in many ways, such as finding the bounding sphere of spheres in any dimension, and so on. However, somehow, the potential extension to computing bounding circles on a sphere got seemingly overlooked. Only when someone tried to design an SPM’s spherical joint, did this problem come into life, after a hiatus of a little over 2.2 thousand years!

² The technical details are skipped in this short article; these are being documented as an article, hopefully to be published in near future.

The above anecdotes intend to convey a common message, and it is rather simple: in order to generate a fruit tomorrow, a plant does need to plan for and produce a flower today; however, the nourishment for the same still comes from the roots which had disappeared into the earth long back, making it easy for everyone to forget them!

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India's Robotics Renaissance –A Strategic Narrative

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India's robotics industry is undergoing a transformative phase, emerging as a key player in the global automation ecosystem. With a market valued at approximately ₹12.2 thousand crore in 2023 and expected to reach ₹30.27 thousand crores by 2030, the sector is experiencing a compound annual growth rate (CAGR) of around 13–14% [1]. According to StartUs Insights, the broader robotics market is poised to grow from ₹4.58 thousand crores in 2025 to nearly ₹6.44 thousand crores by 2033, positioning India among the top five robotic hubs globally alongside the United States, United Kingdom, Germany, and France [2]. This rapid progress is reflected in deployment trends as well; 2024 saw a remarkable 59% increase in robot installations, signaling India's growing appetite for industrial automation [1].

Behind this growth lies the strategic intent of government backed initiatives such as the Make in India and the Production-Linked Incentive (PLI) scheme. These programs are bolstering automation adoption in core sectors like automotive, electronics, and defense [3]. Complementing national policy efforts, state-level projects, such as Karnataka's Uthpadana Manthana have been mobilizing infrastructure investment. With an allocation of ₹3,100 crore towards industrial utilities, the state aims to attract ₹7.5 lakh crore in private-sector investments for capital goods, semiconductors, and robotics over the next five years [3]. What distinguishes India's robotics journey is its focus on task-specific, outcome-driven solutions rather than general-purpose humanoid robots. In early 2025, venture capital investments of over ₹19.83 thousand crore were directed into specialized robots designed for applications like autonomous material handling, remote facility inspections, and intra-logistics [4]. In production-heavy sectors such as chemical manufacturing, rubber processing, and packaging, these collaborative and parallel robotic systems are already integrated into smart factory operations, improving both efficiency and accuracy [4].

An especially notable breakthrough in India's robotics narrative comes from the defense sector. Svaya Robotics, in collaboration with DRDO labs, has developed the country's first indigenous quadruped robot and a load-bearing exoskeleton under the Aatma Nirbhar Bharat initiative [5]. This quadruped robot can navigate rugged terrain while carrying a 25 kg payload, making it suitable for frontline reconnaissance and nuclear facility inspections [5]. The wearable exoskeleton significantly reduces the burden of carried weight for soldiers, transforming 25 kg loads into the biomechanical equivalent of 6–7 kg [6]. This project not only enhances tactical mobility but also symbolizes India's growing independence from foreign robotic systems.

Meanwhile, robotics is finding transformative applications outside industrial domains as well. The humanoid robotics market in India surged from ₹552 crores in 2023 to ₹829.2 thousand crore in 2024

and is projected to grow to approximately ₹13.5 thousand crore by 2035, at a CAGR nearing 29% [7]. Educational robots, a critical subset of this domain, grew from a ₹333.4 crore market in 2024 to a projected 1.65 thousand crore by 2030. Among the most visible examples is Robot Shalu, a humanoid teacher developed in Mumbai using recycled materials, capable of communicating in 47 languages. It is now deployed in several schools as a learning assistant, reflecting how Indian innovation is being tailored to solve local problems in cost-effective ways [7]. This momentum is further supported by a robust academic and research ecosystem. Institutions such as the Indian Institute of Technology Hyderabad, the Central Mechanical Engineering Research Institute (CMERI) in Durgapur, and IIT Bengaluru's MINRO Center of Excellence are actively driving foundational research in AI-robotics integration and cyber-physical systems [8-9]. These centers not only serve as incubators of intellectual property but also catalyze the formation of deep tech startups. One standout example is, based in Kochi, which has developed AI-based robotic arms for industrial testing and recently expanded its reach to global markets through international collaborations [10].

Addverb Technologies, backed by Reliance Industries, has rapidly emerged as a leader in warehouse automation in India. Established in 2016, the company's first plant—Bot Valley, launched in Noida in 2021—was soon followed by the expansive “Bot-Verse” facility in Greater Noida: a mobile-robot manufacturing hub spread over 15 acres with an annual capacity of 100,000 robots and ten product lines serving clients like Flipkart, Amazon, and PepsiCo [11]. In early 2025, Addverb debuted its Trakr 2.0 quadruped at LogiMAT India: a 20 kg payload, 90-minute-endurance robot equipped with vision and gesture controls, along with the Brisk pick-to-voice interface and HOCA carousel system—innovations that extend its automation prowess beyond warehouses into surveillance and inspection domains.

The convergence of favorable policy, technological innovation, and entrepreneurial drive positions India on the brink of a robotics revolution. Opportunities lie in leveraging defense innovations for civilian applications, such as emergency rescue robots and exoskeletons for industrial workers [5-6]. Educational and home-assistive robots are expected to gain widespread acceptance as AI becomes more accessible and component costs continue to fall [7]. However, challenges remain—high capital requirements can deter small and medium enterprises, and a large segment of the workforce still lacks the skills needed to operate, program, or maintain intelligent robotic systems [4]. Standardization, mass manufacturing, and robust supply chains are other critical areas that require attention to ensure scalability and reliability. Overall, India's robotics sector is shifting gears from being a niche frontier to a mainstream enabler of productivity, resilience, and socio-economic transformation. With the right alignment of policy, research, and industry participation, the country is poised not only to adopt but to lead the next phase of robotics innovation globally.

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AMM Supported Events in 2025

AIR 2025

Advances in Robotics conference, IIT Jodhpur | 2 - 5 July, 2025

<https://advancesinrobotics.com/2025/>



Inauguration

The inaugural ceremony of AIR 2025 was graced by the Chief Guest, **Shri E.S. Padmakumar, Director, ISRO Inertial Systems Unit (IISU)**. This event marked the formal opening of the 7th International Conference of The Robotics Society, India, hosted by IIT Jodhpur. The inauguration included welcoming remarks, addresses by dignitaries, and a ceremonial opening to commence the multi-day conference.

Plenary Talks

The plenary sessions at AIR 2025 featured renowned researchers and innovators who made impactful contributions across diverse domains such as bio-robotics, advanced control systems, and robotics system design. These talks provided deep technical insights into current research on human–mechatronics integration, nonlinear control, and cyber-physical systems, offering valuable perspectives to both academic and industry participants.



Prof. Takafumi Matsumaru
Waseda University, Japan



Prof. Venkat N Krovi
Clemson University, USA



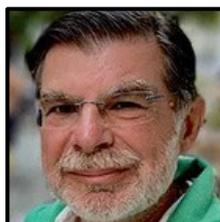
Dr. S.E. Talole
DRDO, India

Keynote Speakers

The keynote addresses at AIR 2025 were delivered by globally recognized experts in the areas like humanoid robot control, space robotics, and robotic dynamics. These visionary talks explored future directions in robot autonomy, impedance control, and mechatronic system design—providing inspiration for interdisciplinary innovation and real-world applications.



Prof. Christian Ott
Professor for Robotics, TU,
Austria



Prof. Evangelos Papadopoulos
Professor, NTU, Greece



Shri. Abishek Kumar
URSC, ISRO

Workshops and Tutorials

AIR 2025 presented a curated series of workshops and tutorials covering key developments in robotics. Workshops focused on areas such as reinforcement learning, medical robotics, robot dynamics using a homegrown software “ReDySim” and drone technologies, while tutorials explored topics including Probabilistic robotics, deep reinforcement learning, surgical systems, and space mission validation. These sessions aimed to equip students, researchers, and professionals with practical skills and insights bridging theory and application.

Doctoral Symposium

The Doctoral Symposium at AIR 2025 offered an interactive platform for PhD scholars to present their ongoing research, gain constructive feedback, and engage in meaningful dialogue with experienced faculty and fellow researchers. The session was designed to encourage mentorship, stimulate new ideas, and build a strong community of emerging roboticists.

Panel Discussion

A thought-provoking panel discussion on “Robotics in India: Synergy Between Industry, Academia, and R&D” convened leaders from government, industry, and academic institutions. The discussion focused on aligning national policy, industrial innovation, and academic research to accelerate the development and deployment of robotics solutions across the country.

CK2025

8th International Workshop on Computational Kinematics
IIT Madras, Chennai, India
25-28 November 2025

8th International Workshop on Computational Kinematics (CK2025)
November 25-28, 2025
Indian Institute of Technology Madras, Chennai, India



<https://ck2025.ammindia.org/>

CK2025 convenes researchers and experts in computational kinematics, with a focus on motion analysis, mechanism design, numerical algorithms, and simulation techniques. Organized at IIT Madras under the aegis of AMM and IFToMM, the workshop follows a single-session format to promote focused discussion and collaboration. Peer-reviewed contributions and invited lectures will foster academic exchange and highlight current advances in the field.

iNaCoMM 2025

7th International & 22nd National Conference on Machines & Mechanisms, IIT Hyderabad, India
7-10 December, 2025



<https://inacomm2025.ammindia.org/>

iNaCoMM 2025, organized by IIT Hyderabad’s Department of Mechanical & Aerospace Engineering under AMM, India, will cover topics such as compliant mechanisms, biomedical devices, multibody dynamics, smart systems, robotics, and mechanism education. Highlights include pre-conference workshops, keynote lectures, a Student Mechanism Design Contest, awards for outstanding contributions, and opportunities for Scopus-indexed publications in reputed proceedings.

ICRAME 2025

23rd ISME International Conference on Recent Advances in Mechanical Engineering (ICRAME), Jaipur, India
17-19 December, 2025



<https://lnmiit.ac.in/isme-2025/>

The 23rd ISME International Conference (ISME-2025) will be held from December 17–19, 2025, at LNMIIT Jaipur, jointly organized with IIT Jodhpur and MNIT Jaipur. The conference will cover emerging research in Machine Design, Advanced Manufacturing, and Thermal-Fluid Systems, with a special focus on AI/ML integration in mechanical engineering. It will feature keynote talks, technical paper sessions, and poster presentations from academia and industry.