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Dr. V. S. Kanchana Bhaaskaran
Vice Chancellor

Foreword from the Vice-Chancellor

The quantum era is no longer a distant scientific curiosity; it is rapidly becoming the foundation of the next technological revolution. It is therefore a matter of great pride and academic enthusiasm that **Vellore Institute of Technology (VIT), Chennai**, hosts the **ANRF sponsored “1st International Conference on Quantum Innovations for Computing and Knowledge Systems (QUICK’26)”**, technically co-sponsored by **CDAC, Govt. of India in association with Deakin University, Australia** bringing together researchers, innovators, and scholars to explore the immense possibilities of quantum science and its transformative role in computing and intelligent systems.

As quantum technologies continue to reshape the boundaries of computation, communication, and information security, interdisciplinary platforms such as QUICK’26 are vital for fostering collaboration between academia, industry, and research institutions.

The conference reflects the growing recognition that quantum technologies will redefine the way complex problems are approached in fields ranging from optimization and cryptography to artificial intelligence and next-generation computing architectures.

In this context, the words of Niels Bohr remain profoundly relevant: “Anyone who is not shocked by quantum theory has not understood it”. These reflections remind us that quantum science challenges our conventional thinking while opening unprecedented opportunities for discovery and innovation.

I commend the **School of Computer Science and Engineering (SCOPE) at VIT Chennai**, along with its collaborators and partners, for organizing this significant international event. The dedication and hard work of the organizing committee, faculty members, researchers, and student volunteers have been instrumental in bringing together a vibrant platform for intellectual exchange and collaborative research.

I also extend my sincere appreciation to the distinguished keynote speakers, technical program committee members, and participants whose scholarly contributions enrich this conference. Their insights and research findings will undoubtedly stimulate meaningful discussions and inspire new directions in quantum-enabled technologies.

I am confident that QUICK’26 will serve as a catalyst for innovative ideas, interdisciplinary collaborations, and ground-breaking research that will shape the future of quantum computing and intelligent knowledge systems.

I wish a grand success of **QUICK’26!**

With best regards,

Dr. (Mrs.) V.S. Kanchana Bhaaskaran
Vice-Chancellor

Foreword by the Pro-Vice Chancellor

It gives me immense pleasure to present the proceedings of the **1st International Conference on Quantum Innovations for Computing and Knowledge Systems (QUICK'26)**, organized by the School of Computer Science and Engineering, VIT Chennai, in collaboration with Quantum Research, School of IT, Deakin University, Australia. This conference marks an important academic milestone in bringing together researchers, industry experts, and scholars to deliberate on one of the most transformative frontiers of modern science and technology.

Quantum technologies are steadily moving from theoretical promise to practical relevance. Their growing influence across computing, artificial intelligence, secure communication, sensing, and advanced materials signals a profound shift in the way we approach scientific discovery and real-world problem solving. In this context, QUICK'26 offers a timely and meaningful platform for dialogue, collaboration, and dissemination of emerging research that can shape the future of computing and knowledge systems.

The papers included in these proceedings reflect the intellectual energy and interdisciplinary spirit that define this conference. They capture current advances in quantum computing architectures, quantum algorithms, quantum artificial intelligence, knowledge systems, materials, devices, and other emerging technologies. I am confident that this collection will serve not only as a record of scholarly contribution, but also as a source of inspiration for future research and innovation.

At VIT Chennai, we are committed to fostering academic excellence, impactful research, and global partnerships that address contemporary technological challenges. QUICK'26 stands as an example of this commitment, and I am pleased to see the enthusiastic participation of contributors from academia, industry, and research institutions across regions.

I extend my sincere appreciation to the programme chairs, organizing committee, reviewers, authors, keynote speakers, and collaborators whose efforts have made this conference and its proceedings possible. Their dedication and scholarly rigor have greatly contributed to the success of this initiative.

I congratulate all the contributors and participants of QUICK'26 and trust that these proceedings will make a valuable contribution to the advancement of quantum research and its applications.



Dr. T. Thyagarajan
Pro-Vice Chancellor
VIT Chennai



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Foreword by the Dean, School of Computer Science and Engineering

It is a privilege to present the proceedings of the **1st International Conference on Quantum Innovations for Computing and Knowledge Systems (QUICK'26)**. Organized by the **School of Computer Science and Engineering, VIT Chennai**, this conference has been conceived as a focused international forum to explore the expanding landscape of quantum science and its growing intersection with computing, artificial intelligence, and knowledge-driven systems.

The field of quantum computing is advancing at a remarkable pace, opening new possibilities for how we process information, solve complex problems, design intelligent systems, and secure digital infrastructure. QUICK'26 has been structured to encourage meaningful academic exchange across a wide range of themes, including quantum computing architectures, algorithms, quantum AI, knowledge systems, quantum materials, devices, and emerging applications. The diversity and depth of the contributions received clearly show that this area is no longer confined to isolated research communities, but is evolving into a highly collaborative and impactful domain.

These proceedings represent the outcome of dedicated research efforts by scholars, scientists, practitioners, and students who are actively shaping this field. Each paper included here has emerged through careful inquiry and has been strengthened by scholarly review and discussion. Together, they offer insights into current challenges, novel methodologies, and future directions in quantum-enabled technologies.

As Dean of the School of Computer Science and Engineering, I am especially happy to note that this conference has brought together expertise across disciplines and institutions, including our valued academic collaboration with Deakin University, Australia. Such partnerships are essential for building strong research ecosystems and for creating platforms where ideas can mature into innovations of lasting significance.

I place on record my heartfelt appreciation to the convenors, programme chairs, technical programme committee members, reviewers, authors, and student volunteers for their commitment and hard work. Their collective effort has ensured the academic quality and professional standard of both the conference and these proceedings.

I hope this volume will be received as a meaningful contribution to the research community and will encourage further exploration in quantum innovations for computing and knowledge systems.

U. Viswanathan

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Chief Guest Address

**Shri. L.Venkata Subramaniam,
Former Head (IBM Quantum),
India Quantum Servant Leader, India.**



Title: Quantum Innovations for Computing and Knowledge Systems

The rapid evolution of computing technologies has consistently expanded humanity's ability to generate, process, and apply knowledge. Today, quantum technologies are emerging as the next transformative frontier in this journey. By leveraging the principles of quantum mechanics—such as superposition, entanglement, and quantum interference—quantum computing introduces fundamentally new approaches to computation that extend far beyond the limits of classical systems.

The theme “Quantum Innovations for Computing and Knowledge Systems” reflects a growing recognition that quantum technologies are not only about building faster computers, but about redefining how knowledge itself can be discovered and utilized. Quantum algorithms hold the potential to address complex optimization challenges, accelerate simulations in chemistry and materials science, strengthen secure communication systems, and enhance the analytical capabilities of modern data-driven environments.

At the same time, the development of quantum computing is deeply interdisciplinary. Progress in this field depends on the convergence of physics, computer science, electronics engineering, mathematics, and software systems, supported by strong ecosystems that connect academia, industry, and government initiatives. Building scalable quantum systems and meaningful applications requires collaboration across these domains, as well as sustained investment in research, infrastructure, and education.

Equally important is the cultivation of a quantum-ready workforce and knowledge ecosystem. Preparing students, researchers, and innovators to engage with quantum technologies will play a critical role in shaping how societies benefit from this emerging paradigm. Institutions that foster interdisciplinary learning, experimental research, and practical engagement with quantum platforms will become central to the next phase of technological advancement.

The contributions presented in these proceedings highlight the expanding scope of research and innovation in this field. They reflect the collective efforts of scholars and practitioners working toward a future in which quantum technologies enhance our ability to compute, discover, and create new knowledge.

As the global quantum ecosystem continues to mature, initiatives in research, education, and industry collaboration will determine how effectively these technologies translate into real-world impact. The discussions and insights captured in this volume represent important steps toward understanding and realizing the potential of quantum innovations in computing and knowledge systems.

Guest of Honor Address

Distributed Quantum Computing for Agentic AI and Generative Modeling in Complex Systems

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Abstract

Complex systems are systems of systems and involve complex, distributed computations that depend on many latent variables that are challenging to measure directly. They utilize multiple sources of both real-time and historical data to identify and represent complex, nonlinear relationships between these critical variables. Agentic AI defines the shift to proactive, autonomous systems capable of planning, reasoning, and executing multi-step tasks while learning from outcomes to achieve goals with minimal human supervision. Agentic and generative models, combined with full-scale process simulation and digital twinning, effectively enhance process control enabling advanced solutions for process optimization, quality improvement, and sustainable operations [3].

Quantum machines, which can do complicated computations with several variables, may train AI systems faster. Quantum computing uses the principles of quantum mechanics to process information and has the potential to perform specific tasks much faster than classical computing. Applications that require large amounts of parallel computing, and the problems that require efficient and accurate simulation of quantum problems in nature are the problems where quantum computers are expected to outperform classical computers [7]. As indicated by researchers [2] quantum computers will not scale in a local device with a large number of qubits in a single quantum processor so a distributed infrastructure with several quantum processors that contain a limited number of qubits is the solution. Distributed computing organizes the computation of a problem in different Processing Units (PUs) connected through an interconnection network. The distribution of computations though comes with a significant overhead of partitioning, communication and synchronization. Quantum machines make complex problems simpler to tackle because of the massive expansion of parameter space. The biggest challenge in creating a huge-scale quantum machine is the *decoherence* of the quantum states used to encode qubits. Whenever qubits communicate with the outside world, they might lose their coherent properties, a phenomenon known as “*decoherence*” [5]. Researchers have identified the need for the tools to parallelize quantum computations across different quantum processors efficiently. Despite a considerable amount of work done on the fundamentals of distributed quantum computing, the ultimate theory of distributable quantum algorithms requires to be established. It is necessary to provide a quantitative definition of quantum circuit distributability [4]. Existing architecting methodologies can be adapted for quantum software thus representing quantum bits mapped to quantum gates as architectural components and connectors that implement quantum software [1].

Quantum computing exploits qubits, superposition, and entanglement to perform computations beyond the reach of classical architectures. Generative models and agentic systems in collaboration can enhance process efficiency, minimize operational risks, and support adaptive control mechanisms [3]. The fusion of agentic AI and quantum computing represents a frontier in digital futures, offering transformative capabilities alongside profound governance challenges [6].

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Keynote Address

**Prof. Subra Ganesan,
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Electrical and Comp. Engineering
Director
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Title: Quantum AI Applications in the Automotive

Quantum AI is a rapidly emerging field that blends the power of quantum computing with the capabilities of artificial intelligence (AI). In the automotive industry, its potential applications could revolutionize various processes, from design and manufacturing to logistics, safety, and autonomous driving. In this presentation, I will cover some of the Quantum AI applications.

Quantum AI has the potential to radically transform many aspects of the automotive industry by enhancing everything from vehicle safety and autonomy to energy efficiency and supply chain optimization. However, the technology is still in its early stages, and many of these applications are theoretical or in the experimental phase. As quantum computing evolves, the automotive sector is likely to see more practical implementations, driving innovations that could lead to safer, more efficient, and more sustainable transportation.

4 Key applications are:

1. Autonomous Vehicle Navigation and Decision Making
2. Predictive Maintenance and Diagnostics
3. Vehicle Safety and Driver Assistance Systems
4. Vehicle-to-Everything (V2X) Communication

IBM, Google, SpinQ, Microsoft, IonQ, and others are developing Quantum processors.

The focus in quantum computing has shifted from merely achieving the next technical milestone to delivering meaningful solutions that benefit society as a whole.

Quantum algorithms, such as Quantum Approximate Optimization Algorithms (QAOA) and Variational Quantum Eigensolvers (VQE), are particularly suited for embedded systems. These algorithms are designed to handle tasks like resource allocation, pattern recognition, and optimization in real-time applications.

Advancements in solid-state qubits and photonic quantum processors are paving the way for room-temperature quantum devices. Hybrid systems, where classical and quantum processors coexist, are being explored to distribute computational tasks efficiently.

Quantum AI can assist in designing post-quantum cryptography (PQC) and Quantum Key Distribution (QKD) systems, ensuring secure communication channels that are resistant to quantum attacks.

Keynote Address

Rakesh Goyal

Director, Telecommunication Engineering Centre,

Department of Telecommunications

Govt. of India



Title : Navigating the Quantum Threat Landscape

The impending realization of large-scale quantum computing presents a dual-edged paradigm shift for global digital infrastructure, offering transformative potential in computational power while simultaneously threatening the cryptographic foundations of modern security. Current public-key infrastructures, which rely on the mathematical complexity of integer factorization and discrete logarithms, are inherently vulnerable to quantum-enabled cryptanalysis via Shor's algorithm. This vulnerability necessitates an urgent transition toward quantum-resistant architectures to mitigate the risk of "harvest now, decrypt later" attacks, where encrypted data intercepted today could be compromised in the near future.

The talk will focus upon the emerging strategies for securing next-generation communication networks: 'Post-Quantum Cryptography (PQC) & Quantum Key Distribution (QKD)' and the various initiatives being taken by the Department of Telecommunications. PQC involves the development and adoption of new cryptographic algorithms based on mathematical problems believed to be resistant to attacks by both classical and quantum computers, enabling secure implementation within existing communication and digital infrastructure. In contrast, QKD leverages the fundamental principles of quantum mechanics to enable provably secure key exchange by detecting any attempt at eavesdropping on the communication channel.

A perspective on how these complementary technologies can be leveraged to build resilient, future-ready secure communication ecosystems in the era of quantum computing would be presented.

Keynote Address

Mr. Manoj Nambiar,
Senior Scientist,
Tata Consultancy Services (TCS), India.



Title: Computing Advantage with Quantum

Modern computing research is fundamentally driven by the need to deliver applications that meet stringent non-functional performance indicators, including low latency, high throughput, energy efficiency, reliability, quality, and cost effectiveness. Today's computing landscape offers a diverse range of execution platforms—from general-purpose CPUs to specialized accelerators such as GPUs, neural processors, and FPGAs. Even with this diversity, decomposing an application into components and mapping each component to the most suitable hardware in order to optimize end-to-end system performance, while satisfying multiple constraints, remains a challenging problem. This challenge is further amplified under dynamically varying workloads.

Alongside mature CMOS-based computing, several emerging paradigms—such as photonic computing, neuromorphic architectures, and spin-based devices—are being actively explored. Quantum computing occupies a distinct position among these technologies due to its potential to address certain classes of computationally intractable problems more efficiently than classical approaches. While this promise is compelling, practical realization is currently constrained by limitations in quantum hardware, algorithm maturity, and system scalability.

This keynote places quantum computing within a broader, system-level computing perspective. It begins by examining the importance of selecting and orchestrating appropriate software components across heterogeneous computing substrates to achieve targeted performance objectives. The talk then discusses representative problem classes in optimization, chemistry, and machine learning where quantum algorithms show potential to deliver meaningful improvements in key performance indicators. The characteristics and limitations of contemporary noisy intermediate-scale quantum (NISQ) hardware are examined, with particular emphasis on variational and hybrid algorithms designed to extract value from such systems.

The session concludes with a discussion of the practical challenges involved in achieving real quantum advantage in industrial settings, including integration with classical workflows, performance benchmarking, and scalability considerations. Insights drawn from TCS's research experiences and ongoing efforts in quantum computing are summarized to highlight lessons learned and directions for future progress.