ATTACHMENT 1: Profile and Detailed Achievements of the Group A Recipient of the 2022 C&C Prize

Dr. Satoshi Matsuoka

Current Positions:
Director, Riken Center for Computational Science
Specially Appointed Professor, Tokyo Institute of Technology

Personal History (born in 1963):

1986	BS, Information Science, the University of Tokyo
1988	MS, Information Science, the University of Tokyo
1989	Research Assistant, Information Science, the School of Science, the University of Tokyo
1993	PhD, Information Science, the University of Tokyo
1993-1996	Assistant Professor, Information Engineering, the School of Engineering, the University of Tokyo
1996-2001	Associate Professor, Mathematical and Computing Sciences, the Graduate School of Information Science and Engineering, Tokyo Institute of Technology,
2001-2018	Professor, Global Scientific Information and Computing Center, Tokyo Institute of Technology
2002	Visiting Professor, National Institute of Informatics
2012-2018	Senior Visiting Researcher, Riken Advanced Institute for Computational Science (AICS)
2016-2018	Designated Fellow, Artificial Intelligence Research Center (AIRC), the National Institute of Advanced Industrial Science and Technology (AIST)
2018	Director, Riken Center for Computational Science Specially Appointed Professor, Tokyo Institute of Technology

Major Awards:

2009	Fellow, International Supercomputing Conference
2011	Fellow, Association for Computing Machinery
2011	Gordon Bell Prize, Association for Computing Machinery
2011	Electrical Science and Engineering Promotion Award
2012	Commendation for Science and Technology in the development category by the Minister of Education, Sports, Culture, Science and Technology (MEXT), Japan
2014	IEEE Computer Society Sidney Fernbach Memorial Award
2018	ACM HPDC Achievement Award
2019	Asia HPC Leadership Award, SCAsia
2020	Fellow, Japan Society for Software Science and Technology
2021	Gordon Bell Prize, Association for Computing Machinery
2021	Contribution Award, Information Processing Society of Japan

2022 Medal with Purple Ribbon, Japan
2022 IEEE Computer Society Seymour Cray Computer Engineering Award

Achievements

Supercomputers constitute an essential tool for fostering innovation in all sorts of fields in modern society, from a variety of science and technology fields and design/manufacturing applications to the creation of smart cities. In fact, supercomputers have become indispensable to computer science (simulation), which is said to be the third science after theory and experimentation. At the same time, there is a demand for high-performance computers in the processing of big data in "data science," the fourth science, so competition in the development of supercomputers as a driver of innovation continues throughout the world.

Dr. Matsuoka has been researching and developing massively parallel supercomputers throughout his career in a variety of fields. He used the results of his work to design the TSUBAME series of supercomputers featuring a hybrid architecture consisting of general-purpose CPUs and graphics processing units (GPUs), the latter of which he introduced in supercomputers for the first time in the world. TSUBAME supercomputers have received top ranking a number of times in various supercomputer computing performance rankings around the world and have been ranked first in energy-saving performance. He also undertook the development of applications in TSUBAME supercomputers, enhanced their design and software systems placing importance on actual application performance, and provided an industry-academia joint-use service that regarded TSUBAME as "everyone's supercomputer." Dr. Matsuoka has also been involved in the research and development of the Fugaku supercomputer from the start making technical contributions to its development, promoting innovative ways of using it, and contributing to many achievements made possible by Fugaku such as simulations of droplet infections by the COVID-19 virus.

Dr. Matsuoka became an assistant professor at the University of Tokyo in 1993 and achieved many results in relation to the development and use of system software for early massively parallel supercomputers such as the Fujitsu AP1000. He then went on to become an associate professor at the Graduate School of Information Science and Engineering, Tokyo Institute of Technology in 1996 where he was involved in the research of grid and cluster computers. From 1998 to 2001, he worked on the construction of the Presto I, II, and III large-scale PC cluster computers. Consisting of 480 general-purpose CPUs, Presto III achieved a computing speed of 716.1 GFLOPS ranking 47th in the TOP500 supercomputer performance ranking in June 2002. This achievement showed that a large-scale and high-

performance computer could be inexpensively constructed in a university research laboratory. In addition, Dr. Matsuoka performed joint research with researchers in the field of applied mathematics and contributed to showing how large-scale problems that could not be solved with existing computers could now be solved.

In 2001, Dr. Matsuoka became professor at the Global Scientific Information and Computing Center (GSIC) of the Tokyo Institute of Technology taking up the development of a practical computer for the university's computing center. In the period from 2002 to 2006, the "Tokyo Institute of Technology Campus Grid" expanded to approximately 650 nodes reaching a computational performance of 2.5 TFlops. This computer led to expanded use of the computing center and was a great success overall. Dr. Matsuoka also spearheaded the development of the TSUBAME (Tokyo-tech Supercomputer and UBiquitously Accessible Mass-storage Environment) grid-type cluster supercomputer. This system connected 655 servers each mounting 8 general-purpose dual-core CPUs in a cluster formation. For the LINPACK benchmark, it reached a speed of 38.1 TFLOPS ranking 7th in the world in the TOP500 rankings of June 2006 and 1st in Japan. Then, with the aim of improving performance even further, he turned his attention to GPUs having high peak performance and memory bandwidth. The result was TSUBAME 1.2, which recorded a LINPACK performance of 77.48 TFLOPS in November 2008 by combining the TSUBAME system with 170 nodes each equipped with 4 GPUs. TSUBAME 1.2 was the world's first supercomputer in actual operation to introduce GPUs on such a large scale.

At the same time, TSUBAME 1.2 brought into light a number of problems with existing cluster-type computers in terms of actual application performance. Dr. Matsuoka developed TSUMABE 2.0 to solve these problems and demonstrate high application performance. This version consisted of 1408 hybrid-architecture nodes each consisting of 2 CPUs and 3 GPUs that increased the intra-node and inter-node connection bandwidth as much as possible to enable sudden increases in calculation speed plus 34 calculation nodes equipped with large-capacity memory. As a result, TSUBAME 2.0 became the world's first supercomputer that could cover computational performance mostly by GPUs and that could be put to practical use 24 hours a day, 365 days a year. It reached a LINPACK computational performance of 1.192 PFLOPS ranking 4th in the world on the TOP500, and it came in 3rd on the Green500 supercomputer energy efficiency ranking. In terms of supercomputers in actual operation, this essentially gave TSUBAME 2.0 the title of top supercomputer in the world. Since then, supercomputers using GPUs have come to be developed throughout the world, and Dr. Matsuoka has come to be recognized as a pioneer in General-Purpose computing on GPU (GPGPU), that is, in

technology that applies the computing resources of GPUs to tasks other than image processing. For these achievements, he was the first Japanese researcher to receive the IEEE-CS Sidney Fernbach Award, a prestigious prize in the supercomputer world marking a peak in the recipient's career.

With TSUBAME 2.0, Dr. Matsuoka came to recognize the importance of energy efficiency, and to further improve the energy efficiency of supercomputers, he constructed the TSUBAME-KFC (Kepler Fluid Cooling) test system that introduced immersion cooling technology. By greatly reducing the amount of power needed for cooling through immersion cooling and adopting various types of power optimization techniques, the TSUBAME supercomputer came to be ranked 1st on the Green500 listing two times in a row from November 2013.

Based on these results, Dr. Matsuoka went on to develop TSUBAME 3.0, which adopted the latest GPUs and optimized system-cooling techniques. Thanks to these upgrades, TSUBAME 3.0 reached a power performance of 14.1 GFLOPS/W and was consequently ranked 1st on the Green500 listing in June 2017 for a supercomputer in actual operation. Incidentally, nine of the top ten supercomputers on the Green 500 listing at this time had adopted GPUs. The power consumed by cooling the TSUBAME 3.0 is about 3% of total operation, which is about one-tenth that of other supercomputers reflecting excellent energy efficiency for a supercomputer in actual use. The TSUBAME 3.0 mounts 540 computing nodes each with 2 CPUs and 4 GPUs. Its theoretical computing performance is 12.15 PFLOPS, 24.3 PFLOPS, and 47.2 PFLOPS for double-precision, single-precision, and half-precision computing, respectively, making for top-class performance in Japan even for the levels of precision required of artificial-intelligence (AI) and big-data processing. In addition, intra-node and inter-node bandwidth has continued to evolve in parallel with improvements in performance, and with a mechanism that enables data anywhere within the machine to be accessed at high speeds in a transparent manner, TSUBAME 3.0 is helping to speed up data-science, big-data, and AI processing while also taking the lead in the use of disaggregated architecture, now a major topic in the Internet Data Center (IDC).

Dr. Matsuoka has also researched many topics in supercomputer system software and performance optimization and has announced many pioneering results. These include achievements in energy savings and fault tolerance in the application of GPUs to supercomputers through various types of algorithms, frameworks, and large-scale supercomputer software, in performance monitoring and dynamic tuning of applications running on computers equipped with mixed-model computing units using GPUs, FPGAs, etc., in various types of discrete algorithms and software frameworks for dramatically raising performance of big-data processing on supercomputers,

in performance modeling suitable to large-scale deep learning, and in large-scale scaling up and acceleration of learning processes through a variety of new algorithms and algorithm frameworks. These achievements did not end simply at the level of journal papers. They have been implemented one after another in TSUBAME and other supercomputers, and for these achievements that Dr. Matsuoka has strived to spread, he was the first Japanese researcher to receive the ACM HPDC Achievement Award in 2018.

Dr. Matsuoka also worked on improving TSUBAME at the application and operation levels and was instrumental in providing Japan's first full-fledged joint-use service for industry of a large-scale university supercomputer known as "everyone's supercomputer." In this way, supercomputer projects have been launched and used not only within the university but also in collaboration with many other universities, research institutions, and private companies producing many results. TSUBAME 3.0 has also come to incorporate many cloud technologies such as virtualization and to play the role as Japan's top science cloud.

In 2018, Dr. Matsuoka became the director of Riken Center for Computational Science (R-CCS) at RIKEN and the leader of the supercomputer Fugaku project. In this project, he has made technical contributions in various forms since 2010. As the leader of R-CCS and vendors, he overcame a variety of difficulties to achieve the final base design and the actual manufacturing and installation of supercomputer Fugaku. Additionally, in 2020, he decided to provide Fugaku, though still in its test phase, for use in dealing with a variety of problems associated with COVID-19 and contributed to many achievements such as simulations of virus droplet infections. As one of the authors of a paper on simulating droplet infections to which he made technical contributions, Dr. Matsuoka received the ACM Gordon Bell Prize for the second time in 2021.

Dr. Matsuoka has chaired ACM, IEEE, and other international conferences in relation to computing and has been active as a leading international figure in this field. In particular, he served as program chair of ACM/IEEE Supercomputing 2013, the world's foremost international conference on supercomputers, as a first for Japan, and came to be the only person to serve as program chair of a major supercomputer international conference in all three main regions in the world including Europe's International Supercomputing Conference (ISC) and Supercomputing (SC) Asia.

Dr. Matsuoka is known for his research in supercomputer configuration methods and system software. It was his intention to develop an easy-to-use computer with importance placed on high-performance, low cost, energy savings, and actual application performance by incorporating GPUs in supercomputers as a world's first and adopting other novel techniques.

He is a worldwide leading figure in supercomputers that have obtained top rankings in the world in many indices including energy efficiency. As the person with overall responsibility in the development of the TSUBAME series of supercomputers open widely to industry and academia as “everyone’s supercomputer” and in the development of supercomputer Fugaku, he led the way from their initial research and development to their actual use. In view of these remarkable achievements recognized around the world, Dr. Matsuoka is certainly a deserving recipient of the C&C Prize.