Dr. Suren A. Chilingaryan
Data Processing and Performance Expert | Lead of Cloud Computing

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I do research in high-performance and heterogeneous computing and apply it to architect online systems for scientific instrumentation. With improvements in detector technology, I believe new approaches are required to keep pace with the increasing data rates. Codesign of hardware, software, and analysis algorithms is often a key for successful projects. Currently, I lead an effort to adopt cloud technologies for data acquisition and control systems.

AREAS OF EXPERTISE

High performance computing
Distributed data acquisition and control systems
Performance analysis and software optimization techniques
Parallel algorithms and parallel hardware architectures
Low-latency communication in heterogeneous systems
Cloud-based data management and visualization

EMPLOYMENT

Since 2013	**Data processing and performance expert** at Karlsruhe Institute of Technology: High-performance instrumentation for large-scale scientific experiments
2007 – 2012	**Postdoctoral researcher** at KIT: Data management & software optimization
2005 – 2007	**Researcher** at Yerevan Physics Institute: DAQ for particle detector networks
2002 – 2005	**Associate researcher** at Forschungszentrum Karlsruhe
2001 – 2002	**Software engineer** at Yerevan Physics Institute

EDUCATION

July 2006	PhD in Computer Engineering "Data Exchange Solution for Distributed Data Acquisition Systems and its application for Cosmic Ray Monitor Networks", National Academy of Science, Armenia
1996 – 2001	MSc in Mathematics "Data Processing using Neural Networks", Moscow State University, Russia

ACADEMIC TRACK RECORD

Experiments	Member of *KATRIN*, *PANDA*, *ASEC* collaborations; contributed to *CMS* and *KIT Cube*
Collaborations	*ESRF*, *CCPi*, *Desy*, *TPU*, *SCI*, *SEVAN*, *YerPhI*
Funding	Contributing author to BMBF grants 01DK13019 (15 k€), 05K10CKB and 05K10VKE (2.5 m€ total), 200 k€ in further infrastructure funding
Projects	Maintain 5 software frameworks, coordinated and developed - 12; 7 are in active use on major facilities
Supervision	Supervise 2 PhD students, co-supervised 4 PhD students (2 graduated), 10 Master students and 20 internships
Tutoring	GPU programming tutorials, seminar on parallel programming
Publications	59 peer-reviewed publications, h-rank: 18
Presentations	7 invited talks, 10 conference talks, 15 seminars

EXPERIMENTS AND COLLABORATIONS

	Current
Since 2020	PANDA: antiProton ANnihilation in Darmstadt, Germany *(Member)*
Since 2013	BESS: Battery Technology Center at *KIT*, Germany
Since 2008	KARA: Karlsruhe Research Accelerator, *KIT*, Germany
Since 2007	KATRIN: Karlsruhe Tritium Neutrino Experiment, Germany *(Member)*
Since 2006	SEVAN: Space Environment Viewing and Analysis Network; coordinated by *YerPhI*
Since 2001	ASEC: Aragats Space Environmental Center, Armenia *(Member)*
	Past
2020 – 2021	CCPi: Collaborative Computational Project for Imaging; led by UOM and STFC
2014 – 2018	HZG: Helmholtz-Zentrum Geesthacht, Germany
2010 – 2018	TPU: Tomsk Polytechnic University, Russia
2016 – 2017	CMS: Compact Muon Solenoid, *CERN*
2016 – 2017	UFO: German-Russian Collaboration on Ultrafast Tomography
2010 – 2017	SCI: Shubnikov Crystallography Institute, Russia
2009 – 2015	KIT Cube: Integrated atmospheric observation system (operated by *KIT*)
2009 – 2015	KIT Tower: Meteorological tower at *KIT* North Campus, Germany
2008 – 2014	TOSKA: Test facility for fusion magnets at *KIT*, Germany
2008 – 2014	ESRF: European Synchrotron Radiation Facility, France

FUNDING

2021	(Author) investments for upgrade of *KaaS* cluster `KATRIN (100 k€)` `KaaS (2021)`
2020	(Contributing author) investments to integrate ROCe protocol in *UFO* DAQ system `KCETA (6 k€)` `RoCE (2020)`
2019	(Technical contribution) to *MT-DTS ST2* subtopic in *Matter and Technologie* program `Helmholtz` `MT-DTS (2021 – 2027)`
2013, 2016	(Technical contribution) projects on collaborative analysis of tomographic datasets `BMBF (750 k€)` `ASTOR (2013 – 2016)` `NOVA (2016 – 2020)`
2012	(Contributing author) networking grant for cooperation with *ASEC* `BMBF (15 k€)` `ADEI (2013 – 2015)`
2011	(Contributing author) *Vaporciyan Multivariate Analysis and Visualization* (non-governmental grant by Armenian diaspora) `Diaspora (100 k$)` `VMAV (2012 – 2014)`
2010, 2011	(Contributing author) *Ultra Fast X-ray Imaging of Scientific Processes with On-line Assessment and Data-driven Process Control* `BMBF (2.5 m€)` `UFO-1 (2010 – 2013)` `UFO-2 (2012 – 2015)`
2009	(Technical contribution) to *HDRI (High Data Rate Processing and Analysis)* initiative in *Helmholtz PNI (Photons, Neutrons, Ions)* research program `Helmholtz` `HDRI (2010 – 2014)`

LEADERSHIP

Since 2020	Leading efforts to prepare *KATRIN* data infrastructure for *Tristan* detector Group: `2 PhD` `2 students`
2018 – 2020	Led development of *KATRIN* cloud platform and migration of services Group: `2 Postdocs` `PhD` `2 students`
2013 – 2018	Led volume visualization task force in *ASTOR* and *NOVA* projects Group: `PhD` `5 students`

2010 – 2018	Coordinated a program on stewardship of theses for *TPU* students Participation: ⬛3 PhD⬛ ⬛12 students⬛
2010 – 2016	Led a collaboration with *ASEC* on online data analysis platform Group: ⬛Postdoc and PhD in *KIT*⬛ ⬛Postdoc and 2 engineers at *ASEC*⬛ ⬛10 students⬛
2010 – 2017	Coordinated work-package on tomographic software in *UFO* project Group: ⬛3 PhD in *KIT*⬛ ⬛3 PhD in partner universities⬛ ⬛5 students⬛

RESPONSIBILITIES

Current

Since 2018	Data management cloud at *KATRIN*
Since 2013	Data management system for *KIT Battery Technology Center*
Since 2011	Software stack of *UFO* data acquisition platform
Since 2007	Slow control system at *KATRIN*

Past

2017 – 2018	Transfer of *UFO* Camera technology to *HZG*
2010 – 2017	Parallel computing cluster for *UFO* project
2013 – 2016	Technology transfer to *ASEC* and *SEVAN* experiments
2009 – 2015	Data portal for *KIT Cube* experiment and *KIT Weather Tower*
2008 – 2014	Maintenance and optimization of a *KARA* branch of *PyHST*
2008 – 2014	Data management system at *TOSKA* and *CULTKA* facilities
2007 – 2009	Integration of *KATRIN* components in centralized control system
2005 – 2007	Data acquisition and data management at *ASEC* and *SEVAN*
2003 – 2005	Intercommunication between *KATRIN* DAQ and NI fieldpoint devices
2001 – 2002	IT infrastructure of *ASEC*

SCIENTIFIC AND OPEN-SOURCE SOFTWARE

Maintain

Since 2018	KaaS: Katrin-as-a-Service data management platform for KATRIN ⬛ands.suren.me⬛ ⬛KATRIN⬛
Since 2015	Bora: monitoring framework for ADEI ecosystem ⬛bora.suren.me⬛ ⬛KATRIN⬛
Since 2011	Alps: Linux driver platform for fast prototyping of PCIe-based electronics ⬛alps.suren.me⬛ ⬛Camera at HZG⬛ ⬛Camera at SCI⬛ ⬛Kapture/Kalypso at KARA⬛
Since 2008	ADEI: cloud platform for visualization and analysis of time-series ⬛adei.info⬛ ⬛KATRIN⬛ ⬛KARA⬛ ⬛ASEC⬛ ⬛BESS⬛ ⬛KIT Tower⬛ ⬛KIT Cube⬛ ⬛TOSKA⬛
Since 2005	ADAS: data acquisition system for ASEC detectors ⬛adas.suren.me⬛ ⬛ASEC⬛
Since 2003	RusXMMS: operations with multilingual strings in non-unicode encodings ⬛rusxmms.sf.net⬛ ⬛RedHat⬛ ⬛OpenSuSE⬛ ⬛Debian⬛ ⬛Ubuntu⬛ ⬛Arch⬛ ⬛FreeBSD⬛

Supervised and coordinated

2015 – 2018	WAVe: JavaScript volume rendering library based on WebGL ⬛wave.suren.me⬛
2012 – 2017	UFO: image-processing framework and a collection of GPU-accelerated algorithms ⬛ufo-kit.github.io⬛ ⬛KARA⬛

Contributions

2020 – 2021	CCPi: Tomographic Imaging Project (*performance optimizations*) `www.ccpi.ac.uk`
2008 – 2014	PyHST: *ESRF* tomography software (*DFI algorithm and performance improvements*) `pyhst2.suren.me` `KARA` `ESRF`

Obsolete

2010 – 2011	MRSES: feature selection algorithm for Intel and PowerXCell architectures
2009 – 2010	DictHW: CUDA implementation of digital image tracking algorithm
2003 – 2009	XMLBench: XML Benchmarking suite

RESEARCH AND DEVELOPMENT

While the focus of my research is computing technologies, the developed instrumentation enabled major scientific break-throughs achieved by KATRIN **katrin2019limit** and ASEC **chili2010thunderstorm** collaborations. Below are referenced selected peer-reviewed publications which are either authored by me and my students or where we made a significant contribution.

Since 2011	**High-bandwidth data acquisition and data-driven control**
2018 – 2019	Fine-tuning of tomographic reconstruction algorithms through micro-benchmarking and performance modeling **csa2020rtip** `UFO` `PyHST`
2016 – 2017	Participated in a case study on applications of GPUs in Level-1 track trigger for the next upgrade of the *CMS* experiment **mohr2017cms** `CMS`
2016 – 2017	Designed a full chain of instrumentation for synchrotron imaging beamlines with possibility of online reconstruction and image-based feedback loop **kopmann2017ufo**, **stevanovic2015concert** `UFO`
2015 – 2016	Researched low-latency communication mechanisms for data-driven control applications **vogelgesang2016dgma** `Alps`
2014 – 2015	Implemented fast DMA drivers with GPUDirect / DirectGMA support **rota2015dma** `Alps`
2013 – 2014	Reviewed asymptotically fast methods of tomographic reconstruction well-fitted for GPU architectures **rshkarin2015** `UFO` `PyHST`
2011 – 2013	Researched software architectures for online processing of image streams **vogelgesang2012ufo** `UFO`
2011 – 2013	Developed streaming data acquisition platform for scientific cameras **caselle2013camera** `Alps`

Since 2007	**Parallel architectures, performance analysis, and software optimization**
2020 – 2021	Applied methods of approximate computing to enable reconstruction of large datasets using memory-intensive regularization methods **ametova2021neutron** `CCPi`
2017 – 2018	Researched performance imbalances and hidden parallelism in GPU architectures; proposed how they can be exploited to speed-up tomographic reconstruction **csa2018sbac** `PyHST`
2014 – 2017	Investigated viable compromises between reconstruction quality and parallelization capabilities of tomographic algorithms **ashkarin2015** `UFO`
2013 – 2014	Developed parallel algorithms for μPIV (micro-particle velocimetry) **cavadini2018upiv** `UFO`
2010	Leveraged PoweXCell architecture for MRSES feature selection algorithm (5000x speed-up compared to MATLAB prototype) `MRSES`
2009 – 2010	Optimized PyHST tomographic reconstruction framework **csa2011pyhst** `PyHST`

2009 – 2010	Implemented a digital image correlation and tracking algorithm for GPUs `DictHW`
2007 – 2008	Carried out a performance study of open-source XML frameworks **csa2009xmlbench** `XMLBench`

Since 1999	**Digitization, data organization, and distributed control systems**
Since 2019	Researching cloud technologies for highly heterogeneous control systems in large-scale scientific experiments [in preparation] `KaaS`
2015 – 2017	Researched remote visualization techniques for large and time-resolved tomographic volumes **ntj2017wave**, **losel2020biomedisa** `WAVe`
2013 – 2015	Researched emerging web technologies for management and visualization of terabyte-scale archives with time-series `ADEI`
2011 – 2014	Converted KATRIN data management system into a full flagged platform for time-series exploration and analysis `ADEI`
2008 – 2010	Developed data management components of KATRIN control system **csa2010adei** `ADEI`
2007 – 2008	Stabilized KATRIN slow control system for production use **katrin2015detector** `KATRIN`
2005 – 2006	Developed a data acquisition system for particle detector networks **csa2009sevan** `ADAS`
2002 – 2004	Researched network protocols for heterogeneous slow control systems **eppler2004opc** `ADAS`
1999 – 2001	Evaluated hardware-accelerated neural networks for trigger applications **vardanyan2001sand**

SUPERVISION AND TEACHING

	Supervised PhD students
Since 2020	2 PhD on adoption of cloud technologies for data acquisition and control systems
	Co-supervised PhD students
2014 – 2018	thesis "Big Data Management and Visualisation"
2013 – 2017	work on collaborative tools for analysis of microtomography data
2013 – 2017	work on low-latency communication protocols for distributed data acquisition systems
2011 – 2016	thesis "An Extensible Parallel Computing Framework for Ultra-Fast X-Ray Imaging"
	Supervised MSc and BSc students
2014 – 2018	5 MSc theses on remote visualization of archives with tomographic data
2013 – 2017	4 students working on fast DMA interconnects between FPGA and GPUs
2011 – 2016	4 MSc and 2 BSc theses on advanced algorithms in tomographic reconstruction
2010 – 2015	10 internships on web technologies for visualization of time series
2014	2 MSc theses on GPU-accelerated algorithms for nano-particle tracking
	Courses and seminars
2019	GPU computing tutorial at ARBRA summer school in Nor-Amberd, Armenia
2014 – 2017	4 student projects at seminar "Advanced topics in Parallel Programming"
2013	GPU computing tutorial at KSETA graduate school at KIT

Selected presentations

Conferences

Oct 2019	(invited) *"Accelerating Remote Visualization of Large Tomographic Data Volumes"* at Global Innovation Forum, Armenia
Oct 2018	(talk) *"Balancing load of GPU subsystems to accelerate image reconstruction in parallel beam tomography"* at SBAC-PAD 2018 conference, Lyon, France
Okt 2014	(talk) *"Computing Infrastructure for Online Monitoring and Control of High-throughput DAQ Electronics"* at 10th PCAPAC conference, Karlsruhe, Germany
Sep 2014	(invited) *"UFO – Status and Perspectives of Ultrafast X-Ray Imaging at ANKA"* and *"Fast Reconstruction Algorithms for Computed Tomography"* at SNI 2014, Germany
Jun 2012	(talk) *"A High Throughput Platform for Real-Time X-ray Imaging"* and *"Advanced Linux PCI Services"* at 18th IEEE Real-Time Conference, Berkeley, CA, USA
May 2012	(talk) *"A High Performance Platform for Real-Time X-ray Imaging"* at GPU Technology Conference, San Jose, CA, USA
May 2010	(talk) *"A GPU-based Architecture for Real-Time Data Assessment at Synchrotron Experiments"* at 17th IEEE Real-Time Conference, Lisbon, Portugal
Apr 2009	(talk) *"Comparison of fast multi-platform XML Libraries: Results for January 2009"* at BenchmarX'09 workshop at DASFAA 2009, Brisbane, Australia
Sep 2007	(talk) *"Advanced Data Acquisition System for SEVAN"* at SEE 2007 Symposium, Athens, Greece

Workshops

Mar 2019	(talk) *"UFO Cloud: Data-Acquisition-as-a-Service"* at *Matter and Technologie* program meeting, Germany
Nov 2018	(talk) *"High-Speed Tomography: Fine-tuning back projection for GPU architectures"* at CAMERA workshop, Berkeley, CA, USA
Nov 2017	(invited) *"UFO - A platform for high data rate instrumentation with GPUs"* at EUCALL GPU/FPGA Workshop at *XFEL*, Hamburg, Germany
May 2017	(invited) *"SHAPe: Scalable and Highly Available Platform for Scientific Data Portals"* at ARBRA Workshop, Nor-Amberd, Armenia
Apr 2017	(invited) *"Tuning tomographic reconstruction for different parallel architectures"* at workshop on Real-Time 3D Tomography, *CWI*, Amsterdam, Netherlands
Jan 2016	(invited) *"Performance-oriented instrumentation for high-speed synchrotron imaging"* at workshop on Large Scale Tomography, Szeged, Hungary
Apr 2012	(invited) *"ADEI for Tango"* at Tango workshop, *MAX-IV*, Lund, Sweden
Mar 2012	(talk) *"Practical Experience with GPUs for high throughput computing"* at *HDRI*/*PanData* workshop
Mar 2011	(invited) *"High Speed Tomography at KIT"* at meeting on Tomographic reconstruction software, *ESRF*
Sep 2008	(talk) *"Advanced Data Extraction Infrastructure"* at FORGES 2008 workshop, Nor-Amberd, Armenia

Seminars

May 2020	(talk) *"Real-time reconstruction for synchrotron tomography"* at lunch-and-learn session at *University of Manchester*, UK
Oct 2018	(talk) *"Balancing load of GPU subsystems to accelerate back projection for synchrotron tomography"* at *ESRF*, Grenoble, France
Apr 2016	(talk) *"ADEI: Intelligent visualization and management of time-series data in scientific experiments"* at *Instituto de Física*, *UNAM*, Mexico
May 2015	(talk) *"Advanced Algorithms for Tomography"* at *YerPhI* seminar, Yerevan, Armenia
Sep 2013	(talk) *"Ultrafast X-Ray Imaging of Scientific Processes"* at *SCI* and *TPU*, Russia