

# ACM MIDDLE WARE 2021

Conference Guide  
for Attendees



## 22nd ACM/IFIP International Middleware Conference

[middleware-conf.github.io/2021](https://middleware-conf.github.io/2021)



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# Foreword

The Middleware conference debuted in 1998, and has since evolved into the premier event for presenting and discussing research and innovations in the field of middleware systems. Middleware technologies focus on the design, implementation, deployment, and evaluation of distributed systems, platforms and architectures for computing, storage, and communication.

The following volume contains the proceedings of the research track of the 22nd ACM/IFIP Middleware Conference, which was held virtually on December 6th-10th 2021. This proceedings is divided into two parts: the first cycle (which was published in August), and the second cycle (which was published in December). Separate volumes are available for the other tracks and workshops.

The 2021 edition of Middleware introduced changes to the submission and review process to further enhance the scope and quality of papers at the conference. Starting this year, Middleware will feature twice-a-year submission cycles that will provide more flexibility to authors to submit research papers as they become ready. In addition to the traditional rigorous review and discussion phases, a new “revise-and-resubmit” process will allow authors to respond to reviewer requests for changes and clarifications with an improved submission that will undergo another round of reviewing. This is the first edition of the conference to adopt this new format and process, with previous editions having only a single submission and review cycle. We are delighted to report that in the first cycle, 8 papers were accepted, out of 22 total submissions. During the second cycle, 21 papers were accepted, out of 81 total submissions. Many of these papers went through a thorough shepherding process resulting in a high-quality program. We are thankful to the TPC members who invested significant time with multiple review and shepherding cycles.

The selected papers present the latest results in both traditional and emerging research areas, including big data, data intensive computing, cloud computing and data centers, serverless architectures, programming abstractions, event-based systems, transactions, monitoring, fault tolerance, security and privacy.

The conference also ran the ACM Artifact Review and Badging process. Authors were invited to submit supporting materials to be made publicly available as source materials in the ACM Digital Library. This submission was voluntary, but encouraged, and did not influence the decision regarding paper acceptance. A separate committee conducted the Artifact Review and Badging process. Out of eight accepted papers in the first round review, two papers submitted their code and dataset for artifacts evaluation and both of them were awarded “Artifacts Available” badge. In the second round review, 12 papers submitted their artifacts (code and datasets) for evaluation, out of which six submissions were granted “Artifacts Available” badges and the other six were granted both “Artifacts Available” and “Artifacts Evaluated (Functional)” badges. The Artifacts Evaluation Committee acknowledges the support from <https://www.chameleoncloud.org/> where most of the artifacts were hosted and evaluated.

In these challenging times, the Middleware Conference would not have been possible without the dedication and coordinated effort of a large team of volunteers and the support of the research and industrial communities at large. The organizers wish to thank all authors who submitted their work during both cycles of a new format, and all the PC reviewers who worked very hard to provide insightful comments and shepherding feedback to the authors.

Finally, we wish to express our sincere appreciation to the Steering Committee and the rest of the organizing team, which consists of the industry chairs, workshop chairs, tutorial chair, poster and demo chairs, doctoral symposium chairs, publicity chairs, sponsorship chairs, artifact evaluation chair, proceedings chairs, registration chair, test-of-time award chair, local chairs, and web chairs. We greatly appreciate your effort towards organizing this year’s Middleware conference!

**Dr. Nalini Venkatasubramanian (PC Co-chair)**  
University of California - Irvine, United States

**Dr. Abdelouahed Gherbi (General Co-chair)**  
École de technologie supérieure, Canada

**Dr. Luís Veiga (PC Co-chair)**  
Instituto Superior Técnico (U.Lisboa) & INESC-ID, Portugal

**Dr. Kaiwen Zhang (General Co-chair)**  
École de technologie supérieure, Canada

# Zoom Instructions\*

ACM Conference 1 is inviting you to a scheduled Zoom meeting.

Topic: ACM Middleware 2021 (All Sessions and Workshops)

Time: Dec 6, 2021 09:00 Eastern Time (US and Canada)

Dec 6, 2021 09:00

Dec 7, 2021 09:00

Dec 8, 2021 08:45

Dec 9, 2021 09:00

Dec 10, 2021 09:00

Please download and import the following iCalendar (.ics) files to your calendar system.

Daily: [https://acm-org.zoom.us/meeting/tJEgcuyhrTkiH9HakTxLDwI4-rmz6\\_mj0Fon/ics?icsToken=98tyKuCtgT4vE9eXuByCRowMB4\\_4Z\\_PztnpHgvp1nRTRGwx3dSqie\\_BPKORAHdKA](https://acm-org.zoom.us/meeting/tJEgcuyhrTkiH9HakTxLDwI4-rmz6_mj0Fon/ics?icsToken=98tyKuCtgT4vE9eXuByCRowMB4_4Z_PztnpHgvp1nRTRGwx3dSqie_BPKORAHdKA)

## Join Zoom Meeting

<https://acm-org.zoom.us/j/95755932855?pwd=WEJDc3hSU3BjWG81ZUIIN2ZSckVmdz09>

Meeting ID: 957 5593 2855

**Passcode: 904398**

One tap mobile

+13462487799,,95755932855#,,,,\*904398# US (Houston)

+16465588656,,95755932855#,,,,\*904398# US (New York)

Dial by your location

+1 346 248 7799 US (Houston)

+1 646 558 8656 US (New York)

+1 669 900 6833 US (San Jose)

+1 253 215 8782 US (Tacoma)

+1 301 715 8592 US (Washington DC)

+1 312 626 6799 US (Chicago)

Meeting ID: 957 5593 2855

Passcode: 904398

Find your local number: <https://acm-org.zoom.us/j/abCJ2gW17A>

Join by Skype for Business

<https://acm-org.zoom.us/j/95755932855>

*\* These instructions may change during the course of the conference, please subscribe to our Slack channel to receive the latest updates*

# Attendee Guide

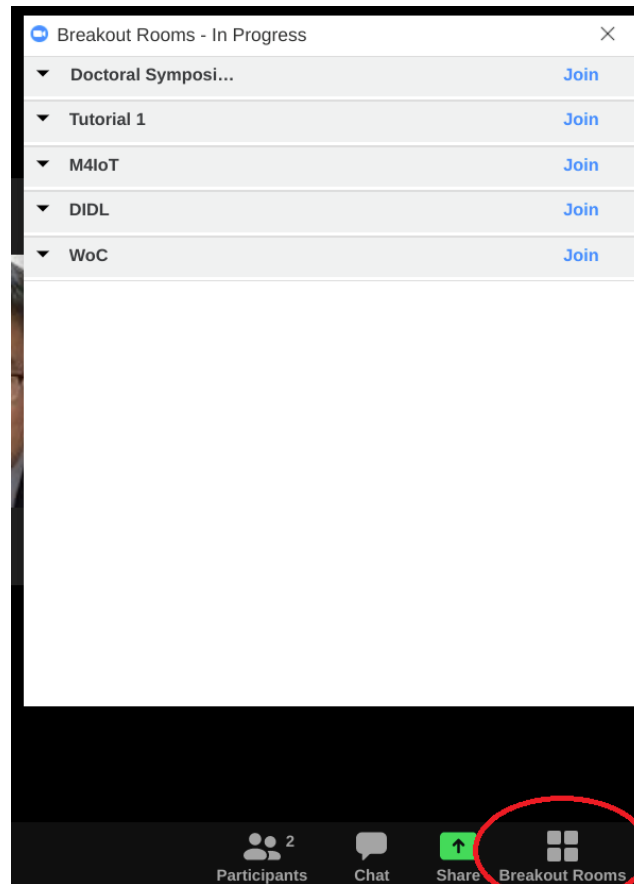
**Program details:** The up-to-date program details can be found on our website: <https://middleware-conf.github.io/2021/full-program/>. The main conference starts on Wednesday, while Monday and Tuesday are reserved for pre-conference activities (workshops, tutorials, and the doctoral symposium). For program details for workshops, please visit their respective webpages.

**Time zones:** All time zones indicated on the website are in Eastern Standard Time (EST), which is the time on the east coast of North America and the local time of the conference. Alternatively, the times can be displayed in Central European Time (CET). For other conversions, please refer to: <https://www.timeanddate.com/worldclock/converter.html?iso=20211206T140000&p1=165> (Enter your city, and change the date and time desired according to the program)

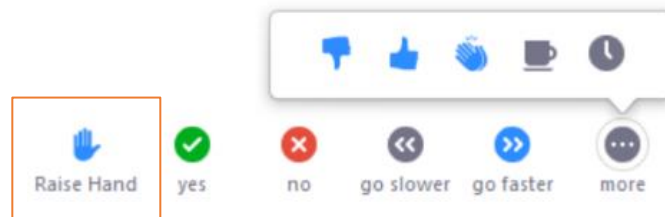
**Slack:** Slack is the official discussion and announcement platform for MW 2021. You are strongly encouraged to join Slack to discuss and connect with other attendees. Slack channels are categorized by session according to the online program. Furthermore, we will announce each session before it starts live on the Slack. You can also ask your questions for specific papers there asynchronously, and they will be relayed to the authors who can respond to them during the live session. The link to the Slack is: [https://join.slack.com/t/middleware-2021/shared\\_invite/zt-zbjh4hg6-pmOQU1hPX9zWk1umz8L5uw](https://join.slack.com/t/middleware-2021/shared_invite/zt-zbjh4hg6-pmOQU1hPX9zWk1umz8L5uw)

**Zoom:** We will be using Zoom for the entire week-long program. Presentations will be broadcasted live on at the pre-defined times according to the program. Furthermore, each presentation will be followed by a Q&A session (see the next section for more details on how to ask questions). To minimize disruption, please mute your microphone when you are not speaking. For convenience, we are aiming to use a single Zoom link for the entire conference, as it is a single-track program for the main conference, and breakout rooms for the pre-conference events (see next section). Please refer to the previous section for instructions. Furthermore, the conference may be re-broadcasted on YouTube to provide an alternate mechanism only for those unable to use Zoom.

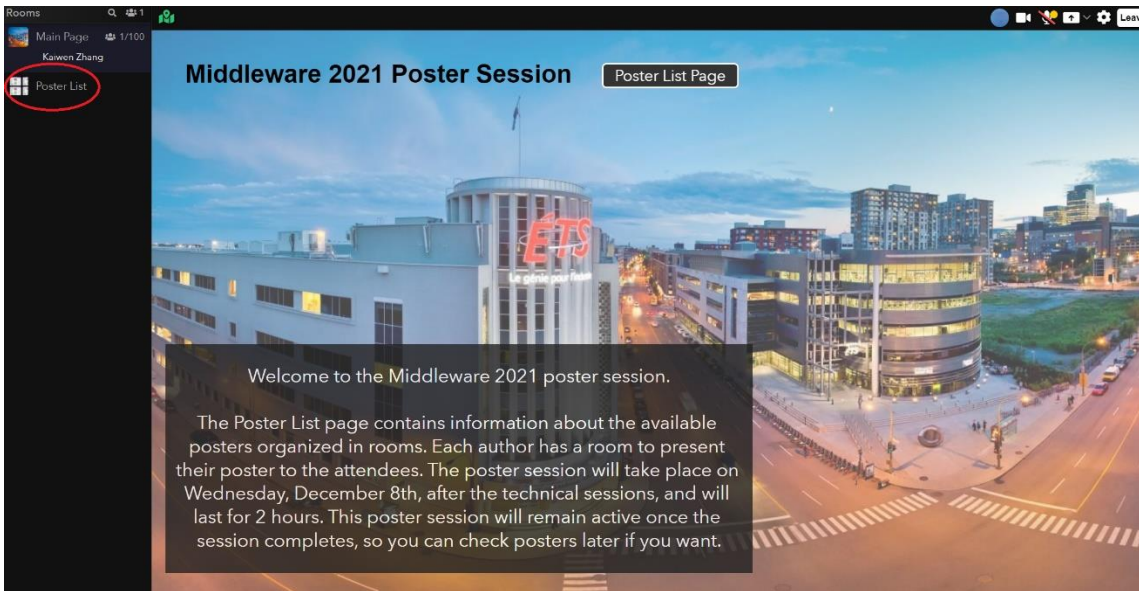
**Workshops, Doctoral Symposium and Tutorials:** **We will use a single Zoom link for all tracks for Monday and Tuesday.** The Zoom meeting will be enabled in “breakout” mode. Each parallel session will be occurring within a single breakout room. Upon joining the room, please click the “Breakout Room” button immediately to join your desired session (See image). For more information please consult the Zoom website: <https://support.zoom.us/hc/en-us/articles/115005769646-Participating-in-breakout-rooms>



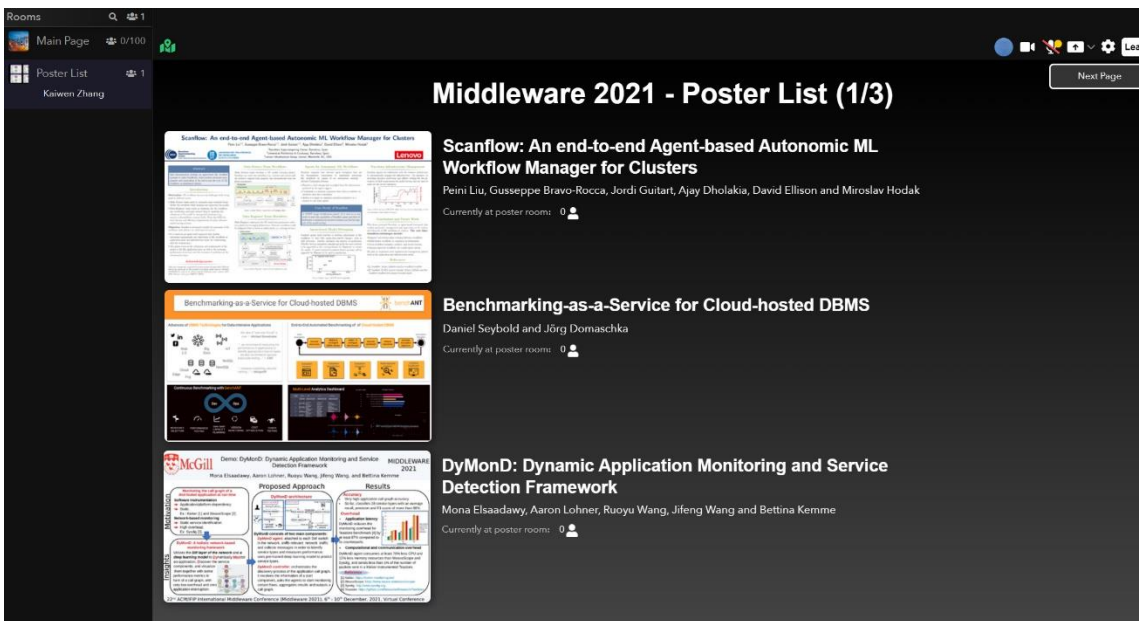
**Asking questions:** We encourage you to discuss and ask questions with our speakers. We provide three methods to ask questions: (1) Asynchronously, in the Slack channel corresponding to the interested paper, (2) Through the Zoom chat, when the live session is taking place, (3) Through the “raise hand” feature in Zoom, in which case you will be prompted to open your mic (and camera) and ask your question directly to the presenter (see the figure below). This feature is usually found in the Participants window. For more information please visit the Zoom website: [https://support.zoom.us/hc/en-us/articles/115001286183-Nonverbal-feedback-during-meetings#h\\_50523139-7bac-403b-9c59-1755ada65ad9](https://support.zoom.us/hc/en-us/articles/115001286183-Nonverbal-feedback-during-meetings#h_50523139-7bac-403b-9c59-1755ada65ad9)



**Demos and posters session (ohyay):** This year, we will be using the **ohyay platform** for demos and posters on wednesday. **The link is:** [https://ohyay.co/app.html?wsid=ws\\_Tx198e1b](https://ohyay.co/app.html?wsid=ws_Tx198e1b). Ohyay is an interactive platform which faithfully simulates small group conversations attendees may have with a demo and poster presenter. Once you click on the link, you will land in the Main page:



From there, simply click on the **Poster List** to access the list of posters:



From there you can access any poster you wish to read and interact with the presenter:



**Rooms** Main Page 0/100 Poster List Kaiwen Zhang

**Join Presenter Spot** **Show Pointer** **Back to Poster List** **Invite Someone Here** **Prev Poster** **Next Poster** **Leave**

**Presenter(s):** Join Presenter Spot

**The presenter is away!**

Attendees: Click "step to the poster" to indicate you want to participate in the conversation about the poster. Add yourself to the wait list if the presenter is busy.

**Step to the poster** **Want to zoom in? Open poster as PDF** **Join waiting list**

Attendee waiting list: (to speak to presenter)

Attendees passing by:

**Scanflow: An end-to-end Agent-based Autonomic ML Workflow Manager for Clusters**  
 Peini Liu<sup>1,2</sup>, Giuseppe Bravo-Rocca<sup>1,2</sup>, Jordi Guitart<sup>1,2</sup>, Ajay Dholakia<sup>3</sup>, David Ellison<sup>3</sup>, Miroslav Hodak<sup>3</sup>  
<sup>1</sup>Barcelona Supercomputing Center, Barcelona, Spain  
<sup>2</sup>Universitat Politècnica de Catalunya, Barcelona, Spain  
<sup>3</sup>Lenovo Infrastructure Group, Lenexa, Morrisville, NC, USA

**Abstract**  
 This demonstration presents an agent-based ML workflow manager (Scanflow), which automates the management and supervision of the end-to-end lifecycle of ML workflows on distributed clusters.

**Introduction**  
 Motivation: ML workflows face several challenges while being used by different teams.  
 • Data Science teams need to automate some repetitive tasks within ML workflows while training and improving the models.  
 • Data Engineer teams need to deploy the ML workflows into production and must operate them to maintain the relevance of the model in unexpected situations (e.g., security vulnerabilities, storage data). They also build the exact latency and efficiency requirements of online inference model serving services.  
 Objective: Scanflow is designed to enable the autonomy of ML workflows with abilities for multi-layered control.  
 • It is based on an agent-based approach that enables autonomic management and supervision of ML workflows at application layer and infrastructure layer (collaborating with the orchestration).  
 • The agents focus on the requirements and requirements of the world at the ML application layer as well as the monitoring performance of services and the structure of workflows at the infrastructure layer.

**Acknowledgements**  
 This work was partially supported by Google as part of Lenovo BSC 2021 collaboration agreement, by the Spanish Government under contract PID2020-107750GB-100, and by the Generalitat de Catalunya under contract 2021-SGR-01410 and under grant 2021-PGR-0027.

**Data Science Team Workflows**  
 Data Science teams develop a ML model (training phase). Scanflow can track the metadata (e.g., metrics, data source) and the artifacts, support their analysis and automatically train the hyperparameters.

**Data Engineer Team Workflows**  
 Data Engineer teams push the ML model into production (inference phase) for increasing inference on. Inference workflows could be deployed either in batch or online mode (i.e., serving services).

**Agents for Autonomic ML Workflows**  
 Scanflow requires four internal agent templates that are the fundamental components for regulating autonomic ML workflows: to manage an automation strategy (e.g., threat containment, defense).  
 • Agent as a control plane that is subject from the observation performed by the agent triggers.  
 • Dashboard as a window expresses the status to whether an agent value the a threshold.  
 • Action is a trigger to standard operating procedures or a response to events, other agents.

**Top-down Infrastructure Management**  
 Scanflow agents can collaborate with the resource orchestration to automatically manage the infrastructure. The instance, by providing resource restrictions and affinity settings for the containers, or QoS requirements for model serving that are used to scale out the service instances.

**Case Study of Scanflow**  
 A MNIST image classification project (Z) is used as a case study to show the capabilities of Scanflow agents and their ability to manage the workflow.  
 Agent-based Model Debugging  
 Scanflow opens work together to perform adjustments in ML workflow in deal with application-layer changes, such as data deviation. Further, Scanflow calculates the number of predictions. Change direct modeler samples and join the most relevant to be expanded in the training dataset for Engineer to refine the model. A model trained to achieve better accuracy will be applied as a Planer to be used in production.

**Conclusions and Future Work**  
 The demo presented Scanflow, an agent-based framework that enables autonomic management and supervision of the end-to-end lifecycle of ML workflows at clusters. The core functionalities/advantages include:  
 • Support with batch/online training/inference workflows.  
 • Multi-deploy workflows as containers or Kubernetes.  
 • Track workflow metadata, artifacts, and model versions.  
 • Managing inference workflows via a multi-agent system.  
 We plan to implement more sophisticated management policies both at the application and infrastructure layers.

**References**  
 • [1] Scanflow: <https://github.com/bcs-scanflow/scanflow>  
 • [2] Scanflow MNIST project tutorial: <https://github.com/bcs-scanflow/scanflow/blob/main/tutorial/tutorial.md>

If you wish to discuss with the presenter, simply click the button “Step to the poster”. If you wish to visit another poster, simply click on “Poster List” again. If you need any help using ohay, please contact us on the #help channel in Slack. The ohay link will be online the entire week should you wish to visit other posters later.

**Awards:** Middleware 2021 will grant 3 awards: the Best Paper award, Best Student Paper award, and the Test-of-Time award. The Best Paper awards will be announced during the business meeting, and the Test-of-time during its respective session on Friday.

**Support team:** A support team, composed of student volunteers, will provide assistance during the conference. If you need any help during the conference, you can address your concerns to @volunteers in Slack and visit the #help channel.

**Business meeting:** MW 2021 will conclude with the business meeting on Friday. This meeting is open to all and provides an opportunity to communicate your feedback and suggestions towards improving future editions of Middleware. You are encouraged to participate. Prior to the meeting proper, we will announce the winners of the Best Paper awards.

**Discussion and lunch breaks:** Each day contains several coffee breaks and one lunch break. You are encouraged to use this time to engage in informal “hallway” discussion, as you would in a physical conference. You can use Slack channels/calls to do so.

**Slack calls:** Slack supports group calls with up to 15 persons. The calls can be either in private by directly contacting another person using direct messages, or publicly in a channel. We recommend using either the #general channel or the session channel corresponding to the discussion you wish to have. To access this feature, click the info button, and click call. Your call will then be displayed in the chat and will allow others to join it. Please see the figure below.

The screenshot displays the Slack interface for the #general channel. At the top, the channel name is followed by a star icon and a member count of 77. An info button (i) is highlighted with an orange box. The right sidebar contains a 'Details' section for the channel, with options like 'Add', 'Find', 'Call' (highlighted with an orange box), and 'More'. The main chat area shows a message from Kaiwen Zhang (General Co-Chair) stating 'You created this channel on June 11th. This is the very beginning of the #general channel. Description: General discussion and coffee break discussion calls can be found here. (edit)'. Below this, a date separator indicates 'Thursday, June 11th'. Another message from Kaiwen Zhang (General Co-Chair) shows 'set the channel description: General discussion and coffee break discussion calls can be found here.' followed by a 'Call' button. A call notification is displayed, stating 'Call Ended' and 'Ended at 3:26 PM - Lasted a few seconds'. Below the notification, it says '1 person joined'.

**Diversity and inclusion:** Middleware 2021 supports those who promote inclusivity and follows ACM guidelines to promote a safe community for all. We take great care to ensure the conference will be inclusive and respectful of the diverse make-up of our community. If you have any concern, you are encouraged to contact the organizing team or the support team in order to take immediate actions. The Middleware conference adheres strictly to the [ACM policies against discrimination and harassment](#).

CALL FOR PAPERS

# ACM Transactions on Storage

*The Leading Journal in Storage Research and Practice*

## **Editor-in-Chief**

Sam H. Noh, UNIST (Ulsan National Institute of Science and Technology), Republic of Korea

## **Information For Contributors**

*ACM Transactions on Storage* (TOS) is the premier journal for publishing advancements in storage research and practice. The field of storage is one of the cornerstones for data availability. Storage is a broad and multidisciplinary area that comprises network protocols, resource management, data backup, replication, recovery, devices, security, theory of data coding, densities, and energy-efficiency. Designing and developing storage systems continues to be a challenge due to both software and hardware heterogeneity in enterprise environments and data centers. ACM TOS seeks to fill an important void as a peer-reviewed comprehensive journal focused on storage.



The scope of ACM TOS includes, but is not limited to, the following areas:

- Storage Systems Architecture, Design, and Validation
- Storage Networking
- Storage Resource Management
- Replication, Backup and Recovery
- Operating System and Application Support
- Information Lifecycle Management (ILM)
- Storage Media and Devices
- Theory



**Visit [tos.acm.org](http://tos.acm.org) for further information  
or to submit your manuscript.**

CALL FOR PAPERS

# ACM Transactions on Modeling and Computer Simulation

*The Archival Source for Quality Research*

## Editor-in-Chief

Francesco Quaglia, University of Rome Tor Vergata, Italy

*ACM Transactions on Modeling and Computer Simulation* (TOMACS) provides a single archival source for the publication of high-quality research and developmental results referring to all phases of the modeling and simulation life cycle. The subjects of emphasis are discrete event simulation, combined discrete and continuous simulation, as well as Monte Carlo methods.

The use of simulation techniques is pervasive, extending to virtually all the sciences. TOMACS serves to enhance the understanding, improve the practice, and increase the utilization of computer simulation. Submissions should contribute to the realization of these objectives, and papers treating applications should stress their contributions vis-à-vis these objectives.

## Scope

The scope of papers published in TOMACS includes, but is not limited to, the following general areas:

- Modeling Methodology
- Model Execution
- Random numbers and objects
- Experiment design and simulation analysis
- Support for conducting simulation experiments, and simulation studies
- Verification, validation, and accreditation of models
- Interplay between other areas of computer science and simulation
- Advanced Applications



On the ACM Digital Library: <https://dl.acm.org/tomacs>

ISSN: 1049-3301 eISSN: 1558-1195



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Visit [tomacs.acm.org](https://tomacs.acm.org) for further information  
or to submit your manuscript.

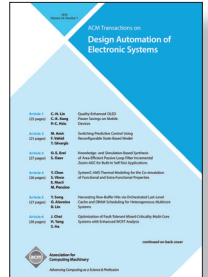
# ACM Journals on Design Methods for Smart and Connected Systems

Featured journals: TODAES, JETC, TECS, TCPS, TIOT & TOSN

## ACM Transactions on Design Automation of Electronic Systems (TODAES)

*ACM Transactions on Design Automation of Electronic Systems* is a premier ACM journal in design and automation of electronic systems. It publishes innovative work documenting significant research and development advances on the specification, design, analysis, simulation, testing, and evaluation of electronic systems, emphasizing a computer science/engineering orientation. Both theoretical analysis and practical solutions are welcome. Topics include, but are not limited to: Architecture- and System-Level Design and Automation; Circuit- and Logic-Level Design and Automation; Emerging Technology and Platform based Design and Automation; Machine Learning for Design Automation and Design Automation for Machine Learning; Physical Design and Design for Manufacturability; Reliability, Verification and Test; and Security for Electronic Systems.

<https://todaes.acm.org>



## ACM Journal on Emerging Technologies in Computing Systems (JETC)

The *ACM Journal of Emerging Technologies in Computing Systems* invites submissions of original technical papers describing research and development in emerging technologies in computing systems. Major economic and technical challenges are expected to impede the continued scaling of semiconductor devices. The journal provides comprehensive coverage of innovative work in the specification, design analysis, simulation, verification, testing, and evaluation of computing systems constructed out of emerging technologies and advanced semiconductors. Topics include: Logic Primitive Design and Synthesis; System-Level Specification, Design and Synthesis; Software-Level Specification, Design and Synthesis; Mixed-Technology Systems; and Interactions of Emerging Technologies and Applications.

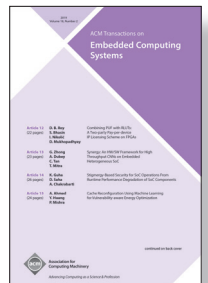
<https://jetc.acm.org>



## ACM Transactions on Embedded Computing Systems (TECS)

The design of embedded computing systems, both the software and hardware, increasingly relies on sophisticated algorithms, analytical models, and methodologies. *ACM Transactions on Embedded Computing Systems* aims to present leading works relating to the analysis, design, behavior, and experience with embedded computing systems. TECS welcomes original research articles, industry design papers, perspectives, tutorials, and surveys that help advance the field by addressing the key challenges.

<https://tecs.acm.org>



To view a listing of all ACM journals in the  
ACM Digital Library, visit <https://dl.acm.org/journals>.



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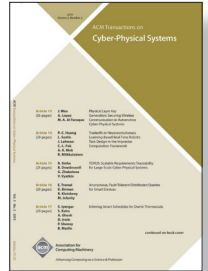
# ACM Journals on Design Methods for Smart and Connected Systems

Featured journals: TODAES, JETC, TECS, TCPS, TIOT & TOSN

## ACM Transactions on Cyber-Physical Systems (TCPS)

*ACM Transactions on Cyber-Physical Systems* publishes high-quality original research papers and survey papers that have scientific and technological understanding of the interactions of information processing, networking and physical processes. TCPS covers Computation Abstractions, System Modeling and Languages, System Compositionality and Integration, Design Automation and Tool Chains, Trustworthy System Designs, Resilient and Robust System Designs, and Human in the Loop. Application domains covered by TCPS include, but are not limited to: Healthcare, Transportation, Automotive, Avionics, Energy, Living Space, and Robotics.

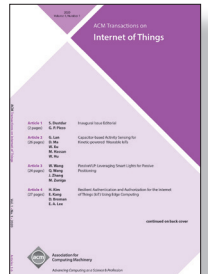
<https://tcps.acm.org>



## ACM Transactions on Internet of Things (TIOT)

*ACM Transactions on Internet of Things* is a new ACM journal that publishes novel research contributions and experience reports in several research domains whose synergy and interrelations enable the IoT vision. TIOT focuses on system designs, end-to-end architectures, and enabling technologies, and on publishing results and insights corroborated by a strong experimental component. All submissions are expected to provide experimental evidence of their effectiveness in realistic scenarios (e.g., based on field deployments or user studies), and the related datasets. The submission of purely theoretical or speculative papers is discouraged, and so is the use of simulation as the sole form of experimental validation. Experience reports about the use or adaptation of known systems and techniques in real-world applications are equally welcome.

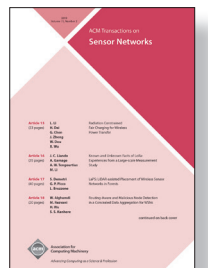
<https://tiot.acm.org>



## ACM Transactions on Sensor Networks (TOSN)

*ACM Transactions on Sensor Networks* serves as a central, archival venue for the interdisciplinary sensor network research community. It covers research contributions that introduce new concepts, techniques, analyses, or architectures, as well as applied contributions that report on development of new tools and systems or experiences and experiments with high-impact, innovative applications. The Transactions places special attention to contributions on systemic approaches to sensor networks.

<https://tosn.acm.org>



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