

# Editorial

## The IEEE TRANSACTIONS ON CONTROL OF NETWORK SYSTEMS and the Evolution of the Field

### I. LAUNCHING TCNS

**T**HE *IEEE Control Systems Society (CSS)* launched the *IEEE TRANSACTIONS ON CONTROL OF NETWORK SYSTEMS (TCNS)* in 2014. The TCNS is financially and technically sponsored by the CSS with technical cosponsors: the IEEE Circuits and Systems Society, IEEE Communications Society, IEEE Computer Society, and IEEE Robotics and Automation Society.

The impetus for the TCNS was the rise in prominence of a new field of science and engineering, coalescing around the study, engineering, and control of *networks* with broad applicability to engineered systems, social science, economics, and biological systems. The broad control systems community that CSS represents was seen as having made important methodological contributions to these areas. Back in 2013, a survey of CSS members indicated that 87% viewed networks as a fast growing area. Consistent with this view was the rise of networks at the IEEE Conference on Decision and Control (CDC). Specifically, while from the 1970s to 2000, the coverage of networks at the CDC grew by about 4%, the growth was about 10% in the period 2000–2010. The TCNS was, therefore, established with the goal, as stated in [item 1) in the Appendix], of becoming the *premier destination for mathematically rigorous papers in network systems*. While, at the time, a discussion took place on whether to align the TCNS closer to applications or rigorous methodological contributions, we consciously decided to emphasize rigor and align the journal with the style of work the CSS is known for. All TCNS papers are required to contain a novel, rigorous mathematical result, and the editorial board is routinely rejecting without reviews papers that lack such a contribution.

The TCNS was launched almost in parallel with several other journals focusing on networks from the perspectives of other IEEE societies. In particular, the Computer Society launched the *IEEE TRANSACTIONS ON NETWORK SCIENCE AND ENGINEERING* and the Signal Processing Society launched the *IEEE TRANSACTIONS ON SIGNAL AND INFORMATION PROCESSING OVER NETWORKS*.

The CSS gave me the responsibility (and distinct honor) to become the TCNS Founding Editor-in-Chief (EiC). The inaugural editorial board, assembled in 2013, included M. Egerstedt as Deputy Editor-in-Chief (D-EiC), P.R. Kumar, N. Leonard,

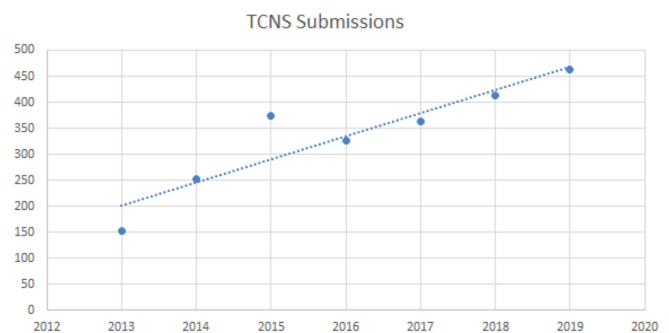


Fig. 1. Submissions to the TCNS since its launch.

S. Low, and J. Shamma as Senior Editors (SEs), and a group of 20 Associate Editors (AEs) well known for their work in network systems. An inaugural *ad hoc* advisory/steering committee included J. Baillieul, C. Cassandras, F. Doyle, B. Krogh, and R. Tempo.

To publish the inaugural TCNS issue (March 2014), we opened submissions in the summer of 2013 and received 120 papers, from which we selected 11 using a variety of criteria, including quality, strength of the reviews, recommendations by the AEs and SEs, and whether the work in the paper demonstrated the broad footprint of the TCNS. Since their publication, papers in the inaugural issue have collectively been cited 1394 times (as of January 2020 according to Google Scholar), demonstrating a large interest in the TCNS, and more broadly networks.

### II. CURRENT STATE OF THE TCNS

Six years after its launch, it is time to ask how the experiment CSS undertook has fared.

Submissions are strong and growing. During the last year, 2019, the TCNS received 464 submissions. Fig. 1 shows the evolution of submissions since 2013. We fitted a linear regression to the submissions (dotted line), which yielded the equation  $y = 44.393x - 89161$ , where  $x$  is the calendar year (e.g., 2019) and  $y$  the number of papers predicted by the model. The model has an  $R^2 = 0.85$  and it implies a healthy annual growth rate of 10.5%. Comparing this to the growth rate of network papers at the CDC reported in Section I, this research area seems to now be growing annually at the same rate it was then growing in a decade.

The TCNS is a highly selective journal. We analyzed *final* editorial decisions for all papers submitted during 2013–2018. TCNS decisions are categorized as follows: (1) accepted without changes, which are made after a paper undergoes at least one round of revisions; (2) conditionally accepted, subject to typically minor revisions; (3) provisionally rejected, which are rejections that encourage the authors to undertake a major revision and resubmit as a new submission; (4) rejected, which are rejections without encouragement to resubmit; (4I/S)—rejected by the Editorial Board, which are rejections without reviews because the paper is viewed as either out-of-scope or of low enough quality to be sent for reviews.

Type (2) decisions are “transient” since (almost) all these papers are resubmitted and the vast majority gets accepted. For the purposes of this analysis, we considered Type (3) decisions as final since the paper is rejected, even though a significantly rewritten paper could be resubmitted as a new submission. The analysis of the 2013–2018 decisions yielded the following distribution of final decisions: i) 27% for (1) Decisions; ii) 0% for (2) Decisions; iii) 32% for (3) Decisions; iv) 25% for (4) Decisions; v) 16% for (4I/S) Decisions.

Naturally, and since we looked at final decisions for each paper, the transient state of (2) Decisions has a 0% occupancy. We note that the percentage of editorial rejections (Type (4I/S) Decisions) is not trivial. Following IEEE guidelines, such decisions are taken by the EiC, after consulting with the D-EiC and at least one AE and/or SE. In a setting of increasing submissions and limited number of qualified reviewers, we view these decisions as protecting one of the most valuable resources—good reviewers—TCNS relies upon to select papers.

The TCNS has had the good fortune of receiving papers that make an impact in the field. It was quickly accepted into the Extended Science Citation Index, and since 2019, the TCNS has been accepted into the *Science Citation Index* published by Clarivate Analytics. In the 2019 release of the *Journal Citation Reports (JCR)*, the TCNS had a first official *impact factor* of 4.802, which is equal to the citations in 2018 per paper published during 2016–2017. A similar metric is published by *Scopus* but it considers a three-year window. Specifically, the 2018 TCNS Scopus CiteScore was equal to 5.80 (equal to the citations in 2018 per paper published during 2015–2017). The corresponding 2017 TCNS Scopus CiteScore was equal to 6.31. Finally, the TCNS is listed by Scimago,<sup>1</sup> which computes the *Scimago Journal Rank (SJR)*. This is a metric, computed similarly to the Google Page Rank, that takes into account which journals cite TCNS papers and computes the stationary distribution of the Markov chain whose states are journals and transitions correspond to Journal *A* citing a paper from Journal *B*. The TCNS SJR was 2.1 in 2018 and 2.8 in 2017. According to Scimago, the TCNS has 7.38 cites per paper in 2018 (computed over a 4-year window), an *h-index* of 28, and is ranked second in the control and optimization category and third in signal processing. All these metrics indicate that TCNS is on par or ahead of well-established journals in the field. It is also notable that the TCNS is well ahead

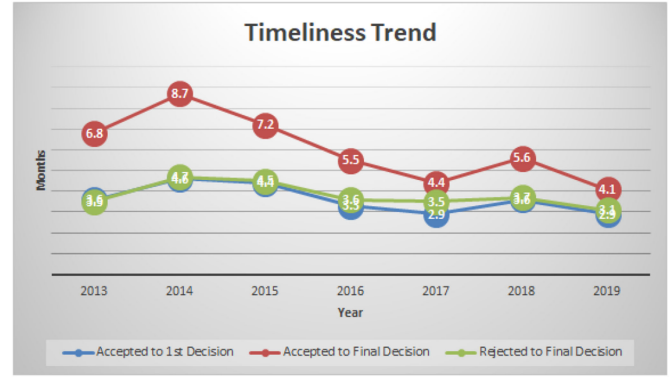


Fig. 2. Timeliness metrics.

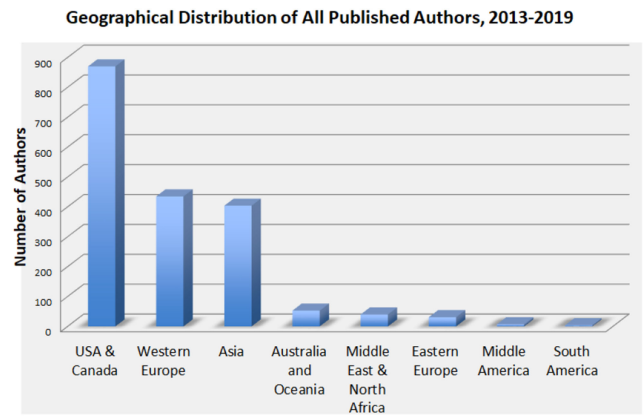


Fig. 3. Regional geographical distribution of published TCNS authors for papers submitted from 2013 to 2019.

of other journals on networks that launched at roughly the same time. Of course, every single metric should be taken with a grain of salt. As we comment later, individual metrics provide a narrow snapshot and can be manipulated.

An important metric of service to the authors is the time that it takes to reach decisions. The initial goal we set was to make the first decision for each paper within three months from the time of submission. The TCNS had some growing pains, as we experienced a large number of early submissions and the process of growing the Editorial Board had inherent delays. Fig. 2 plots average timeliness statistics for the TCNS from 2013 to 2019. Due to the efforts of our Editorial Board and the TCNS Editorial Office, we have reached a point where papers that are accepted have a first decision within 2.9 months, papers that get rejected have a final decision within 3.1 months, and papers that get accepted have a final decision within 4.1 months.

We also computed the geographical distribution of all contributing authors in accepted TCNS papers that were submitted during the period 2013–2019; see Fig. 3. The geographical regions were based on the authors’ institutional affiliation; we have no way of knowing the authors’ nationality or country of birth.

<sup>1</sup><https://www.scimagojr.com/>

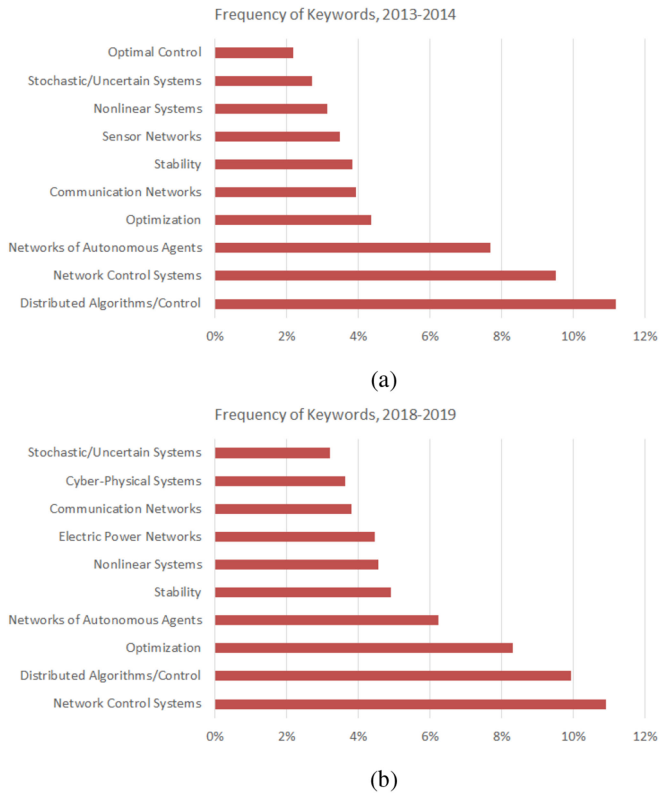


Fig. 4. Frequency of the ten most popular keywords for submitted papers over two different time periods. (a) Keyword distribution, 2013–2014. (b) Keyword distribution, 2018–2019.

### III. EVOLVING RESEARCH TOPICS

When the TCNS was launched, its scope was crafted to include control of networks with applications in many areas, from engineered systems, to social science, economics, and biological systems. It is interesting to assess what actually happened and characterize the most popular topics addressed by submitted papers. Fig. 4 plots the frequency of the ten most popular keywords associated with submitted papers during two periods, 2013–2014 and 2018–2019. It is clear that while methods, engineered systems, and control were covered, we did not receive as many papers with explicit applications in socioeconomic or biological systems. One can speculate that such papers target more applied venues where people in these communities typically publish; particularly so for papers with biological applications. One can also notice that network control systems, distributed algorithms/control, and multiagent systems remain among the most popular topics, which is not surprising for the TCNS. We can also observe that quintessential control topics such as stability, nonlinear systems, and stochastic/uncertain systems have a rather invariant distribution.

What is also interesting is to observe how the prominence of various topics changed from the early TCNS years to the more recent submissions. Specifically, communication and sensor networks lost popularity to give way to optimization, likely boosted by applications in data science, electric power networks,

and cyber-physical systems. These changes likely reflect how research in control systems is changing over time.

### IV. TALES FROM THE TRENCHES

Serving as EiC of a journal, as exciting and worthwhile as it can be, requires daily attention and work. From 2013 to the end of 2019, we have handled as many as 2344 papers. Over more than six years, since July 2013, when submissions opened, I have seen it all.

I have seen protests from authors who are convinced their paper is the best written after Shannon’s 1948 paper on a mathematical theory of communication, and reviewers and AEs who, to put it mildly, did not seem to endorse this view. I have been told by AEs of authors calling them to make a case for their paper. I have seen reviewers spend hours of work on a specific paper and writing a long, detailed review. I have also seen reviews that one could write after spending a few minutes scanning through the paper. I have seen Editors spending many hours handling papers and doing it fast, efficiently, and professionally. Unfortunately, and thankfully rarely, I have seen AEs not living up to the commitment they made when appointed. In one particular and memorable case, an AE sent me a treatise on how he would deal with papers only to disappear from the face of the earth a month later. These cases have been few, but particularly frustrating because they generate more work for everyone else who does her/his job well and is called upon to resolve a crisis. I have also seen the devotion of Editors dealing with family and personal health emergencies handling papers despite all else they had to deal with.

By and large, ours is a community with fair scientific standards, devotion, thirst for scientific discovery, and a culture of volunteering to serve. Consistent with this view is a little “fun” statistic on TCNS submissions. (“Fun,” of course, is subject to definition and as it will next become clear, our definition of “fun” as a community is not perfectly aligned with the rest of the world.) Analyzing all submissions during 2013–2019, reveals that 20% were submitted on a weekend (Saturday or Sunday) in the U.S. Even though submissions come from many countries, the vast majority come from the U.S. and Canada, Western Europe, and Asia. Hence, Sunday evening in the U.S. is dawn in Western Europe and AM in Asia, which does not refute the conclusion that we, as a community, work around the clock.

Perhaps most surprising to me has been an increasing tendency by some authors to use their accepted papers as a vehicle for increasing their bibliometric indices. We have had to deal with accepted papers where more than 30% of references were self-citations. Based on our limited sampling, this is a growing trend that reveals how the emphasis on numerical bibliometric indices for tenure and other evaluations leads to efforts to manipulate these metrics. In response, the TCNS has instituted a policy that encourages self-citations to be kept to an absolutely necessary minimum and can reject papers that include citations for the purpose of influencing bibliometric indices. As a scientific community, we need to do more and return to a culture where quality trumps quantity and opinions are formed

by reading papers and not Google scholar metrics. This is an issue that is clearly much broader than control, and arguably, more pronounced outside control.

## V. IT TAKES A VILLAGE

The TCNS, and I personally, owe much to many individuals who have worked tirelessly and contributed to bringing up the journal. D-EiCs M. Egerstedt and J. Shamma, SEs P.R. Kumar, N. Leonard, S. Low, J. Shamma, K. Johansson, N. Shroff, S. Martinez, M. Di Bernardo, A. Scaglione, Y. Mostofi, and L. Schenato, and more than 60 individuals who have served as AEs are due much credit for all their work. C. Cassandras (past CSS president and TCNS Steering Committee Chair) and F. Doyle (past CSS Vice President of publications, President, and TCNS Steering Committee member) were instrumental in shaping the initial vision and obtaining IEEE approval for the TCNS. Many thanks are due to the rest, current and former TCNS (permanent) Steering Committee Members: J. Baillieul, B. Krogh, P.R. Kumar, R. Tempo, and P. Varaiya. CSS VPs of Publications (F. Bullo, F. Dabbene, and T. Parisini), CSS VPs of Finance (E. Chong, R. Bitmead, M. Egerstedt, and J. Sun), CSS Presidents (Y. Yamamoto, J. Farrell, E. Valcher, F. Doyle, E. Chong, F. Bullo, and R. Bitmead), and the entire CSS executive committees over this period have been very supportive of the TCNS.

The TCNS could not be run without the efficiency, attention to detail, devotion, and hard work of the editorial office, staffed

initially by D. Joseph and currently by M. Stanton. I owe apologies to my students for slowing them down due to the TCNS work. Last, and most importantly, I owe much to my family for their unlimited love, support, and tolerance to my working habits exaggerated by the TCNS.

It is a bittersweet moment to come to the end of my tenure as TCNS EiC. The TCNS is in the great hands of the incoming EiC J. Shamma and D-EiC A. Scaglione. I wish them, and the entire Editorial Board, best of luck, continued success, and ... patience.

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and Division of Systems Engineering  
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## APPENDIX RELATED WORK

- 1) I. C. Paschalidis and M. Egerstedt, "Editorial: The inaugural issue of the IEEE transactions on control of network systems," *IEEE Trans. Control Netw. Syst.*, vol. 1, no. 1, pp. 1–3, Mar. 2014.



**Ioannis Ch. Paschalidis** (M'96–SM'06–F'14) received the Diploma degree in electrical and computer engineering from the National Technical University of Athens, Athens, Greece, in 1991, and the M.S. and Ph.D. degrees, both in electrical engineering and computer science, from the Massachusetts Institute of Technology (MIT), Cambridge, MA, USA, in 1993 and 1996, respectively.

In September 1996, he joined Boston University, Boston, MA, where he has been ever since. He is a Professor and Data Science Fellow with Boston University having appointments with the Department of Electrical and Computer Engineering, the Division of Systems Engineering, the Department of Biomedical Engineering, and the Faculty of Computing and Data Sciences. He is the Director of the Center for Information and Systems Engineering. He has held visiting appointments with the MIT and Columbia University, New York, NY, USA. His current research interests include the fields of systems and control, networks, applied probability, optimization, operations research,

computational biology, and medical informatics.

Dr. Paschalidis was the recipient of the National Science Foundation CAREER award (2000), several best paper and best algorithmic performance awards, and a 2014 IBM/IEEE Smarter Planet Challenge Award. He was an invited participant at the 2002 Frontiers of Engineering Symposium, organized by the U.S. National Academy of Engineering and the 2014 U.S. National Academies Keck Futures Initiative Conference. From 2013 to 2019, he was the Founding Editor-in-Chief for the IEEE TRANSACTIONS ON CONTROL OF NETWORK SYSTEMS.