

## 48th and 49th International Conferences “Decision and Control” (IEEE CDC/CCC 2009 and CDC 2010)

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The Control Systems Society (CSS) of the Institute of Electrical and Electronics Engineers (IEEE) holds in mid-December for many years in succession the annual Conferences on Decision and Control (CDC) that are one of the largest in the series of conferences on automatic control. The role of this conference was mentioned in the notes of A.L. Fradkov [1]. A detailed historical information about CDC can be found in [2], one of its authors M. Spong was the Chairman of the Organizing Committee of the 49th CDC.

The largest, 48th conference of the CDC series took place in December 16–18, 2009 in Shanghai (China) in parallel with the 28th Chinese Control Conference (CCC). As was indicated in the paper of the co-Chairman of the Organizing Committee J. Bailleul [3], of 3105 papers that were submitted to the conference, 1480 (less than 48 %) were selected for presentation and publication by 8000 reviewers and 110 members of the Program Committee. The second co-Chairman of the Organizing Committee was a young, 48 years old, academician Lei Guo, the pupil of the famous Han-Fu Chen who in the 1950s studied at the Department of Mathematics and Mechanics of the St. Petersburg State University. More than 13 hundred papers were selected for the 49th conference that took place in December 15–17, 2010 in Atlanta (USA) at the Hilton hotel.

High scientific level of the CDC conferences and the possibility to make in undertime a publication included into various prestigious bases of indices and citations account for their popularity. The processes of paper submission, reviewing, and compilation of the technical program with the use of the [www.paperplaza.net](http://www.paperplaza.net) portal are very unified and almost completely automated, which enables the organizers to carry out all preparatory work quickly and with good quality. Publication of the conference papers in December and their delivery to the participants at registration enables them to work efficiently with the “fresh” material presented just in the last September.

The present author was lucky to participate in both conferences in Shanghai and Atlanta. The paper of Fradkov [4] with his impressions of CDC-2004 proved to be useful for organization of the missions. Unfortunately, his observation that the fingers of one hand sufficed to calculate the representative of this country at such large and important conference was again true.

The conference program traditionally took four days. The preliminary first day was opened by registration, training seminars, and welcome party. The following three days were devoted to the scientific program. Each day was opened by a plenary session followed by parallel sessions of several sections usually including six twenty-minute papers. In 2009 in Shanghai there were 213 sessions, 25 sessions including 6 poster sessions were held in parallel. In 2010 in Atlanta the papers were divided into 191 session, 24 sessions were held in parallel, and almost the entire second half of December 16 was allotted to 23 poster sessions. The technical program was almost completely prepared in several months preceding the conference and placed on sites, so that each participant

Table

Key words	CDC 1994, 144 sessions (Orlando, USA)	CDC 2000, 160 sessions (Sidney, Australia)	CDC 2004 160 sessions (Nassau, Bahamas)	CDC 2009 213 sessions (Shanghai, China)	CDC 2010, 191 session (Atlanta, USA)
Networks, Agents, Cooperative +Decentralized, Consensus, Formation	5	6	24	27 5 (6)	26 1
Identification, Estimation, Filtering	14	19	13	18	16
Optimal, Optimization	11	7	12	8	11
Stochastic	10	7	6	9	9
Uncertainty				2	1
Randomized					1
Quantum				4	1
Distributed, Delay	10	5	10	9	7
Hybrid, Switching	1	7	12	8	8
Sliding				3	3
Nonlinear	20	29	13	8	7
Adaptive	10	4	4	6	7
Robust	16	8	4	7	6
Robot	6	4	3	5	7
Biomedical	–	2	3	2	5
Applications	3	15	16	10	4
Fault, Diagnosis	1	4	3	5	3
Automotive	2	1	1	2	3
Aerospace	3	2	7	4	2
Vehicle	–	–	5	3	1
Discrete Event Systems	7	3	3	3	1
Process Control, Manufacturing	4	3	4	3	1
Mechanical	3	2	3	3	1(bio- mechanical)

was able to generate in advance—also via the site—its own program including selected papers. Without such work, it is practically impossible to attend all activities of interest. The organizers were adhering strictly to the schedule, so that the majority of participants did not “sit” at the sessions, but every twenty minutes was able to change rooms. Such high “mobility” has a negative side, because the majority of sessions just came to hearing papers without general discussions of the ideas and perspectives.

It is impossible to describe in a nutshell all new ideas and tendencies discussed at the conferences. The general insight into the priorities can be gained from the statistics of the key words in the session names. Along with the materials borrowed from [4] and concerning the CDCs of 1994, 2000, and 2004, the following table presents similar data for the two last conferences. Among the dominating lines of research remained those represented by *networks, agents, cooperative*—27 in 2009 and 26 in 2010; *identification, estimation, filtering*—18 and 16, respectively, *stochastic, uncertainty, randomized*—11 and 11; *optimal, optimization*—8 and 11; *hybrid, switching*—8 and 8; *nonlinear*—8 and 7; *adaptive*—6 and 7; *robust*—7 and 6; and *robot*—5 and 7. The surge of interest in the control of various networks—communication, sensor, or collectives of interacting objects (agents, robots, satellites)—that was noticed in [3] persists. At the same time, the tendency to

increase the number of sessions having “applications” in their titles evidently stopped and even came abruptly to an end, having reduced in six years by the factor of four (from 16 in 2004 to 4 in 2010.) and returning almost to the level of 1994. The number of sessions with “nonlinear” in the titles reduced approximately to the same level as with two other traditional notions of the control theory “adaptive” and “robust.” The disappearance of the term “mechanical” from the session names deserves special analysis.

Another explicit characteristic of the tendencies and priorities is represented by the choice of lecturers and themes of the plenary sessions. In Shanghai in 2009 there were three plenary lectures:

- “Poisson Processes and the Design of Finite State Controllers” by R.W. Brockett (Harvard University);
- “Towards a System-Theoretic Foundation for Control over Networks” by P.R. Kumar (Illinois University);
- “New Opportunities for Control: Quantum Internal Model Principle and Decoherence Control” by T.-J. Tarn (Washington University);

four half-plenary lectures

- “Information Aggregation in Complex Dynamic Networks” by A. Jadbabaie (Pennsylvania University);
- “What Are Moment Problems and Why Are They Useful in Systems and Control?” by A. Lindquist (Royal Technological Institute, Stockholm, Sweden);
- “Target Choice, Control Energy, and Communication Complexity: Facets of an Information-Based Distributed Control System” by Wong Wing Shing (Chinese University of Hong Kong);
- “Differential Geometric Approach in Control and Modeling of Vibrational Mechanics” Pengfei Yao from the Chinese Academy of Sciences;

and the since 1989 traditional plenary lecture dedicated to the memory of Henrik Bode and regarded as a recognition of the lecturer’s outstanding merits:

- “Mean Field Stochastic Control” by P.C.aines (McGill University).

In Atlanta in 2010 there were two plenary lectures:

- “Tall Transfer Functions, Singular Spectra and Econometric Modeling” by B. Anderson (Australian National University);
- “Randomization in Systems and Control: a Change of Perspective” by M. Campi (Brescia University, Brescia, Italy);

two half-plenary:

- “Why Should I Care About Stochastic Hybrid Systems?” Joao Hespanha from the University of California in Santa-Barbara (USA);
- “Switched Systems With Positivity Constraints: Theory, Applications and Open Problems” by M.E. Walcher from the Paduva University (Italy);

and the plenary Bode lecture:

- “The Role of Theory in Control Practice” by M. Morari (Swiss Federal Institute of Technology (ETH), Zurich, Switzerland).

The general impression of CDC 2009 in Shanghai was as follows. A great forum of experts who know what to do now and know what to do tomorrow, but at the same time there was no feeling of “freshness,” and it was difficult to grasp the perspective among the diversity of details. Among the plenary lectures, the presentation of Kumar has stuck in mind first of all owing to its systematic inference of the three historical generations in the development of the control theory. Having started in XIX century from the controllers of mechanical systems, passed by the end of the XX century the stage of profound integration with the digital data processing and decision

technologies, in XXI century the control theory more and more focuses on the plant networks. One of the natural outcomes of this process is represented by the revival in a new light of the notion of “cybernetics” as a “collector” of the three main components of the progress of the second half of the XX century: the Control Theory, Communication Theory, and Computer Science =  $S^3$  (see the review [5]).

Already the preliminary analysis of CDC 2010 in Atlanta created the impression of its greater concentration. These expectations came true, and as the result a much stronger charge of “ideas” and “tendencies” was gained. In addition to the general conceptual points, at CDC 2010 both plenary lectures considered the problem of restoring from observations the transfer function of a linear control plant in noise, which is explained by the change of the traditional stable formulations of the problems and notions. Even recently it was believed by many that there was no place for the intellectual breakthroughs is such typical “trite” problems and it was only possible to “polish” some details. I would like to dwell in more detail on both lectures.

Anderson spoke about executing real tasks of the all-European and American structures controlling the financial systems and characterized by the fact that the observed vector  $y$  has over 150 components, whereas there are only four inputs to the model  $u$ . The problem lies in restoring from observations both the transfer function and inputs of the model  $u$ . If both dimensions are great, then no specificity is seen in the problem, and one may try standard approaches to solve it. However, for greater dimensions these approaches will not be operable. It was shown in the lecture that under the selected, essentially different dimensions the problem of this type can be solved in a reasonable time with the use of the traditional facilities. There was no detailed substantiation of the input dimension four, and only references were given to support this model by practice. This formulation of the problem seemed new and promising from the standpoint of the new compressive sensing (CS) approach, see [6].

Campi spoke about the changes in the outlooks for the control theory that are brought about by the use of randomization in systems and control. One should not confuse randomization with randomness or stochasticity. It is a question even of the traditionally deterministic formulations of the problems. *Randomization* implies that the researchers (subjects) add chance in the system or control. The author gave a nice illustration of the possibility of changing the perspectives. He meant at that two aspects:

- First, in many traditionally complicated problems that are unsolvable in a reasonable time the randomized scenario approach allows one to solve by selecting an a priori finite number of scenarios from a continuum of possible uncertainties the problem with predefined probability almost for all values of uncertainties, except for the set of the a priori defined small measure.
- Second, for the linear systems with arbitrary external noise, the input randomization allows one to construct without defining the noise level the confidence domains of given probability including the unknown parameters of the transfer function, and in many cases these domains can asymptotically collapse.

Campi drew a seemingly paradoxical conclusion which is very important for the control theory: the “weak point” of using the traditional identification (Bayesian) approaches in the problems of control (especially additive) lies in insufficient variability of the observed data, lack of a sufficiently representative sample under fixed parameters of system state, and, as the result, in impossibility of justified use of one or another traditional method of estimation under uncontrollable perturbations. Introduction in the system of a certain controllable randomization enables one to use updated variants of the traditional approaches with the substantiated knowledge of the statistical characteristics of the random processes introduced into the system (randomization).

Another characteristic feature of the conferences lies in carrying out at the free time (usually together with dinner) of open thematical discussions of topical problems and presentation of prizes

to winners of various awards of the IEEE Control System Society. One of the interesting round tables where the present author was able to participate was organized by B. Pasik-Duncan and devoted to the problems of teaching disciplines allied with the control theory. At that, the question of attracting and motivating the young was of greatest concern to the speakers.

The next, 50th jubilee conference on decision and control will be held in December 12–15, 2011 in Orlando (Florida, USA) together with the European Control Conference. One may learn about the past and future conferences in more detail at the site [www.ieeecss.org](http://www.ieeecss.org) of the Control System Society.

In conclusion, I would follow [4] in noticing importance of such forums for development of science, support of the well-established scientific schools, and promotion of the young people interested in science. Hopefully, the national traditions will revive, and Russian activities of the CDC level similar to the All-Union Conferences on Control Problems of the last century will appear again. The Third Multiconference on Problems of Control held on the basis of OAO “Concern “TSNII “Elektropribor” in October 2010 is a positive symptom [7].

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