Artificial Intelligence in Transportation ABJ70

Triennial Strategic Plan - Draft
TRB Committee on Artificial Intelligence & Advanced Computing Applications (ABJ70)
Chair: Sherif Ishak, UAH
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OUTLOOK STATEMENT

Recent initiatives to stimulate the application of emerging technologies into Intelligent Transportation Systems (ITS) continue to inspire innovative cutting-edge approaches to collect, transmit, share, fuse, analyze, and interpret staggeringly large amounts of data for better operation and management of the transportation system. Traditionally, the transportation community relied on data sampling and conventional statistical methods to draw inferences for decision support systems. Today, Big Data sources and the Internet of Things call for artificial intelligence and deep machine learning tools to develop self-learning algorithms that are capable of performing calculations on all data, and consequently, eliminating sampling errors and producing more accurate and precise prediction and prescriptive analytics for a wide spectrum of transportation applications. Viable examples that are shaping the future of our transportation system include the development of real-time decision support systems and subsystems for next generation advanced traffic management systems and centers, shared-use mobility and ridesharing services, crowdsourcing applications, connected and automated vehicles functions, smart infrastructures and cities, among others. In essence, the digital transformation in the transportation system today is largely attributed to the widespread application of disruptive technologies, including big data, the Internet of Things, artificial intelligence tools, machine learning algorithms, and cloud computing techniques.

The TRB Committee on Artificial Intelligence (AI) and Advanced Computing Applications (ABJ70) is poised to play a critical role in promoting and advancing the applications of AI and Machine Learning tools through strategic research, education, and outreach initiatives. In essence, the core mission of ABJ70 is to bridge the Computer Science and Information Technology community with the transportation community in order to leverage more effective and efficient methods for solving challenging problems in all areas of transportation. ABJ70 will focus its research and education activities on the deployment of AI and Machine Learning tools to address current critical issues and challenges at the intersection areas of emerging technologies and transportation applications.

In recent years, the committee identified and consolidated its research areas of expertise into the following eight broad categories of artificial intelligence and advanced computing methods: (1) Artificial Intelligence, (2) Fuzzy Systems, (3) Genetic Algorithms, (4) Neural Networks, (5) Intelligent Agents, (6) Soft Computing, (7) Data Fusion, and (8) Decision Support Systems. In addition, the committee continues to embrace more advanced and evolving tools and methods of deep machine learning such as convolutional neural networks, long short term neural networks, deep Q networks, deep belief networks, and others.

In terms of transportation applications, ABJ70 has sponsored research in a broad range of topics that include estimation, detection, identification, recognition, classification, characterization, optimization, analysis, forecasting, and prediction in planning, operation, management, control, and safety applications. Of particular interest to the committee are research topics in the emerging applications of connected and automated vehicles, big data analytics, and smart communities and cities. Automated driving represents one application in which deep learning is used to automatically detect and recognize objects in the driving environment such as pedestrians, stop signs and traffic lights. The committee is also poised to promote the use of advanced artificial intelligence tools for developing real-time decision support systems/subsystems for the next generation of traffic management systems and centers.

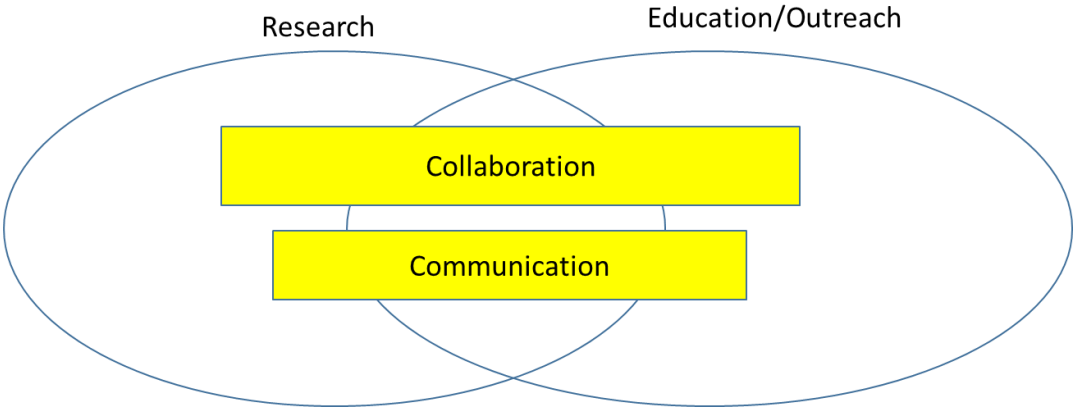
STRATEGIC GOALS

- Identify the critical transportation issues and challenges that are best tackled by AI and Machine Learning tools
- Take the lead on educating the transportation community about the critical role of AI and Machine Learning tools in Big Data Analytics
- Leverage collaboration with TRB committees and professional societies on research and education activities
- Encourage research collaboration among members and friends of the committee
- Utilize the best communication platforms to reach out to and stay connected with the ABJ70 community
- Embrace a collaborative leadership style and promote a diverse and inclusive environment among committee members and friends

COMMITTEE PLAN

To achieve the strategic goals outlined in the outlook statement, ABJ70 is committed to executing a set of strategic initiatives in five areas: (1) research, (2) education/outreach, (3) collaboration, (4) communication, and (5) leadership. The figure below depicts the interaction between the various elements of the strategic plan and demonstrates how collaboration and

communication activities support research and education/outreach activities. The specific action plan for each of the five areas is provided next.



RESEARCH

- Develop research needs statements that are focused on applications of AI and Machine Learning methods in collaboration with other committees whose research scope overlaps with ABJ70 focus areas
- Form focus groups among members and friends of ABJ70 with common research interest to promote research collaboration
- Organize data analysis competition at the annual TRB meeting with emphasis on AI and machine learning tools, individually and collaboratively with other committees
- Review the criteria for nomination and selection of the best paper award (Kikuchi-Karlaftis)
- Evaluate and improve the paper review process by updating the expertise database of reviewers and recruiting more reviewers
- Develop more focused calls for papers to leverage research in areas of special interest
- Promote data sharing among members and friends for research collaboration
- Track citations of the papers published by ABJ70 and the contributions of ABJ70 members to authorship of published and presented TRB papers

EDUCATION AND OUTREACH

- Sponsor Sunday workshops on Big Data and Machine Learning with the goal of (1) addressing possible confusion in the definition of Big Data, (2) introducing new analytic techniques such as deep learning, (3) identifying examples of Big Data sources to tap into, and (4) developing research problem statements
- Organize webinars for selected ABJ70 papers addressing cross-cutting and critical issues
- Produce a primer/circular on emerging AI tools and transportation applications

- Plan for sponsoring a conference or symposium on the transportation applications of AI and Machine Learning tools
- Build an online resource library for AI community
- Reach out to and engage technology companies that are doing innovative research on using advanced AI and computing techniques for transportation data analysis, vehicle and traffic control, and transportation system modeling and simulation

Collaboration

- Leverage more collaboration opportunities with committees in the data and information systems section such as ABJ80, ABJ30, and ABJ60
- Continue collaboration with the freeway operations committee (AHB20) on co-sponsoring Sunday workshops for decision support systems for traffic management systems and centers
- Continue collaboration with the highway-vehicle automation committee (AHB30) on sponsoring breakout sessions on AI and Machine Learning for vehicle automation at the annual Automated Vehicles Symposium
- Identify TRB committees whose research focus is on applications AI tools have successfully been applied to and seek collaboration with on sponsoring workshops and sessions at the TRB meeting and other events (e.g. AFF40 on Testing and Evaluation of Transportation Structures)
- Participate in the committee chairs networking session at TRB to identify committees with overlapping interest and seek partnerships on cross cutting issues
- Designate ABJ70 members serving on other committees as liaisons for ABJ70
- Seek collaboration with editors and associate editors of journals on special calls for papers

Communication

- Keep the committee's website and other social media outlets up to date
- Produce an e-newsletter once or twice a year, highlighting the committee's activities and accomplishments
- Seek innovative methods to facilitate communication among community members and build stronger connections
- Hold mid-year meetings by tagging to summer conferences and events wherein a large number of members are expected to attend
- Develop timelines for the various activities and important dates on the website
- Reach out to stakeholders from the industry, government, organizations, and professional societies

LEADERSHIP

- Increase the number of international and young members on the committee
- Encourage young members to take on leadership responsibilities and inspire senior members to mentor young members
- Promote active participation and better coordination among all members of the committee
- Leverage opportunities for friends to make contributions to the various activities
- Recruit members from the industry and government on the committee

COMMITTEE HISTORY

This section describes briefly the history of this committee and its activities.

RECENT HISTORY (2015-2018)

In the past three years, the committee has experienced fast growth in its sponsored/co-sponsored activities at TRB, as well as the size and diversity of membership. Below is a summary of the activities in the past three years.

Paper Reviews

The table below shows statistics from the paper review process, which can be summarized as follows:

- An increase in the number of papers reviewed by the committee from 23 in 2015 to 112 in 2018
- An increase in the number of papers submitted in response to the call for papers from 22 (38%) in 2016 to 59 (53%) in 2018
- An increase in the size of the reviewers' pool from 93 in 2015 to 458 in 2018
- An increase in the number of non-members in the reviewers' pool from 79 (75%) in 2016 to 430 (94%) in 2018
- An increase in the number of active reviewers from 67 in 2015 to 342 in 2018
- An increase in the number of active non-member reviewers from 49 in 2015 to 314 in 2018

Metric	2015	2016	2017	2018
# papers submitted to ABJ70	23	58	77	112
# papers responded to ABJ70 CFP		22	23	59
% papers responding to ABJ70 CFP		38%	30%	53%
# reviewers in pool	93	106	402	458
# committee members in pool	25	27	26	28
# non-members in pool		79	376	430
% non-members in pool		75%	94%	94%
# assigned reviewers	67	77	201	342
# assigned reviewers (non-members)	49	54	175	314

The following table shows the performance of reviewers over the last three years, which is summarized below:

- An increase in the number of assigned reviews from 143 in 2015 to 829 in 2018
- An increase in the member workload from 2.72 papers in 2015 to 7.36 in 2018, as well as an increase in the acceptance and completion rates
- A decrease in the workload of non-members as a result of the large increase in the size of the reviewers' pool

Performance Evaluation	2015	2016	2017	2018
# assigned reviews	143	264	560	829
Invitations/Member (Assigned Member workload)	2.72	3.91	6.04	7.36
Pending/Member (Reluctance factor)		0	0.85	0.07
Acceptance/Member (Engagement factor)		3.74	4.73	6.93
Declined/Member (Service factor)		0.17	0.46	0.36
Completed/Member (Yield factor)		3.61	4.73	6.43
Invitations/Friend (Assigned Member workload)		3.22	2.3	1.98
Pending/Friend (Reluctance factor)		0.07	0.23	0.32
Acceptance/Friend (Engagement factor)		2.74	1.62	1.26
Declined/Friend (Service factor)		0.41	0.45	0.39
Completed/Friend (Yield factor)		2.61	1.56	1.19

The next table shows the paper review statistics which can be summarized as follows:

- A high average of accepted requests and completed reviews per paper (nearly 5 in the last two years)

Metric	2015	2016	2017	2018
Requests/Paper	6.22	4.55	7.27	7.4
Pending/Paper		0.07	0.81	0.93
Accepted/Paper		4.03	5.29	5.28
Declined/Paper		0.45	1.18	1.2
Completed/Paper	4.39	3.86	5.14	4.95
% with 3 Reviews		24	12	5
% with 4 Reviews		67	14	26
% with 5 Reviews		7	36	40
% with 6 Reviews		2	26	26

The table below shows the number of papers submitted and accepted for presentation and for publication over the past four years. The numbers show a significant increase in the papers presented and published by the committee, which reflects the growing interest in artificial intelligence and advanced computing applications in transportation over the past few years.

Metric	2015	2016	2017	2018
# Submitted for Presentation	6	58	77	110
# Submitted for Publication	10	44	61	93
# accepted for Presentation	12	29	38	60
# accepted for publication	3	9	12	TBD

Sponsored/Co-Sponsored Events

- 2018:
    - Appointed 12 new members: 11 members during 2017 rotation and one filled after resignation of one member (3 from industry, 2 State DOTs/FHWA, 7 academia)
    - Issued a call for paper on Artificial Intelligence (AI) Algorithms for Data Analytics and Emerging Technologies in Transportation
    - Sponsored two podium sessions and two poster sessions (total 60 presentations)
    - Co-sponsored a session on New Research on Driver Safety and Eco-Driving to Study Vehicle Performance and Crash or Near-Crash Events with Data and Information Systems (ABJ00); Roadway Safety Data (ABJ20-1)
    - Co-sponsored a workshop on Big Data Applications and Methods in Transportation with Urban Transportation Data and Information Systems (ABJ30); Transportation Issues in Major Cities (ABE30); Information Systems and Technology (ABJ50); Geographic Information Science and Applications (ABJ60);

Visualization in Transportation (ABJ95); Transportation Demand Forecasting (ADB40)

- Co-sponsored two sessions on Using Decision Support Subsystems to Automate the Use of Traffic Operational Strategies and Control Plans, Part 1, and Decision Support Subsystems for Next Generation Traffic Management Systems and Centers, Part 2 with Freeway Operations (AHB20); Regional Transportation Systems Management and Operations (AHB10); Traffic Signal Systems (AHB25)
- Co-sponsored a workshop on Real-Time Decision Support Requirements for Next-Generation Traffic Management Systems and Centers with Freeway Operations (AHB20); Regional Transportation Systems Management and Operations (AHB10); Intelligent Transportation Systems (AHB15); Subcommittee on Active Traffic Management (AHB20(5)); Traffic Signal Systems (AHB25)
- Co-sponsored a session on Workforce Development and Training: Cross-Cutting Issues and Solutions with Transportation Education and Training (ABG20), Task Force on Knowledge Management (AB010T), Standing Committee on Management and Productivity (ABC20), Subcommittee on Education (ABC40-5), Standing Committee on Technology Transfer (ABG30), Subcommittee on Training, Education & Technology Transfer (ABR10(5)), Subcommittee on Training and Certification (AHD65(4))
- Co-sponsored a workshop on Innovations in Freight Data with ABJ90 and other committees, held at Arnold and Mabel Beckman Conference Center, Irvine, California, on May 17-18, 2017, and a circular sponsored by FHWA, Office of Freight Management and Operations
- Sponsored a breakout session at the Automated Vehicles Symposium on Artificial Intelligence (AI) and Machine Learning (ML) for Automated Vehicles (AV): Exploring Tools, Algorithms, and Emerging Issues, held in San Francisco in July 2017 and featuring six presentations.

- 2017:
  - Sponsored two podium sessions and one poster session (total 38 presentations)
  - A call for paper on Artificial Intelligence (AI) Algorithms for Data Analytics and Emerging Technologies in Transportation
  - Formed a committee leadership team (CLT) of the Chair, Secretary, and Subcommittee Chairs (research, education/outreach, and communication). The CLT is responsible for reviewing membership applications, revising strategic plan, developing annual action plan, etc.
  - Co-sponsored Big Data Analytics in Transportation Workshop with Travel Survey Methods (ABJ40), Information Systems and Technology (ABJ50), Geographic

Information Science and Applications (ABJ60), Statistical Methods (ABJ80), Transportation Demand Forecasting (ADB40)
    - Co-sponsored a session on Innovative Big Data Solutions for Transportation Challenges with Urban Transportation Data and Information Systems (ABJ30), Subcommittee on Urban Big Data (ABJ30(2)), Information Systems and Technology (ABJ50), Transportation Demand Forecasting (ADB40)
    - Co-sponsored a session on Smart Accessibility for Smart Cities with Task Force on Data for Decisions and Performance Measures (A0030T), Task Force on Knowledge Management (AB010T), Urban Transportation Data and Information Systems (ABJ30), Regional Transportation Systems Management and Operations (AHB10), Public Transportation Planning and Development (AP025), Metropolitan Policy, Planning, and Processes (ADA20)
    - Co-sponsored a session on Big Data Innovations for Big Decisions with Urban Transportation Data and Information Systems (ABJ30), Subcommittee on Urban Big Data (ABJ30(2)), Information Systems and Technology (ABJ50), Transportation Demand Forecasting (ADB40)
    - Organize a total of eight webinars and selected the best paper for the Kikuchi-Karlaftis award
    - Released the first issue of its e-newsletter in July 2016 (Vol. 1 No. 1) featuring a message from the Chair, call for papers and big data workshop announcement, profile of the committee leadership team members, membership roster, and banner with a new logo for the committee
- 2016:
    - Sponsored two podium sessions and one poster session at TRB (29 presentations)
    - A call for papers on Artificial Intelligence (AI) and Algorithms for Data Analytics
    - Co-sponsored a Big Data Sunday Workshop with Travel Survey Methods (ABJ40), Information Systems and Technology (ABJ50), Geographic Information Science and Applications (ABJ60), Statistical Methods (ABJ80), Transportation Demand Forecasting (ADB40)

Social Media Outlets

The committee established presence in most social media outlets such as:

- LinkedIn: http://www.linkedin.com/pub/sherif-ishak/7b/636/772
- Twitter: Follow us @TRBabj70
- Facebook: https://www.facebook.com/trbabj70/

This is in addition to the committee website at:

https://sites.google.com/site/trbcommitteeabj70/Welcome

Previous History (Prior to 2015)

The TRB Committee on Artificial Intelligence and Advanced Computing Applications began as a Task Force on Expert Systems (A5T54) in the mid-1980s. The Task Force grew out of a need recognized by professionals who were active in the highway community and knowledgeable about the potential benefits offered by expert systems to transportation professionals. A chronology of the Task Force follows:

- January 1985, Annual TRB Meeting - preliminary discussions held relative to starting a Committee on *Expert Systems*.
- March 1985 - Draft proposal submitted to TRB for the establishment of a Committee on *Expert Systems*.
- September 1985 - Final proposal submitted to TRB for the establishment of a Committee on *Expert Systems*.
- January 1986 - "Boxed Session" of interested participants held during TRB.
- January 1986 – Dr. R. A. Harris made presentation to the Group 5 Council for the establishment of a Committee. The idea was approved, but as a Task Force instead of a committee.
- June 1986 - Task Force officially approved and membership appointed.
- January 1987 - 1st official meeting held during TRB.

Dr. Harris served as the Task Force chair for the three years of its existence. At its final meeting, in 1989, the Task Force membership determined that a permanent committee would be beneficial to the transportation industry and appointed four individuals to write the committee proposal: Olin Mintzer, Mike Demetsky, James Wentworth, and Gary Spring. The latter three served as the committee's first three chairs.

The initial purpose of the *Expert Systems* Committee was:

"To provide a focal point for expert systems research activities across the various transportation related disciplines, and to act as a forum for the evaluation and dissemination of information relative to the applications of the technology to the transportation profession"

In 1992, the Committee broadened its focus (and changed its name) to include other Artificial Intelligence application areas such as Knowledge Based Systems, Neural Networks, and so on. It changed its name to "Committee on Artificial Intelligence" and revised its subcommittee structure to reflect this broader view. Its scope was as follows:

"To provide a focal point for all forms of artificial intelligence research activities across the various transportation-related disciplines, and to act as a forum for the evaluation and dissemination of information relative to the benefits of the technology to the transportation profession"

In 2006, the committee changed its name to Committee on Artificial Intelligence and Advanced Computing Applications (ABJ70) to include the computational aspects. This is a natural evolution of the committee activities and focus. Originally, the emphasis was *Expert System*, or ruled-based representation of causal relations. The committee's interest and direction has diversified to Artificial Neural Networks (ANN), Genetic Algorithm (GA), agent-based modeling, and other computation intensive tools. At the same time, the committee has gradually established solid foundation in fuzzy set theory, uncertainty theory, and wavelet. The domain of AI will continue to grow as more tools are developed.

ABJ70 Committee is a new generation of transportation engineers and planners who are eager to obtain new knowledge of Artificial Intelligence, hybrid methods, and any innovative analytical approaches and apply to the real-world transportation problem. The committee is also unique that the number of international members is large; this allows a global based exchange of ideas and greater opportunities of application.