Consensus reaching in multi-agent decision making: the role of fuzzy logic, human judgments, biases and fairness analyses

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Abstract

Decision making processes involving multiple agents (individuals, actors, decision makers, etc.) is concerned, and small groups of agents are assumed. The agents provide theirn testimonies, here their (fuzzy or graded) preferences. As a point of departure the reaching of consensus is discussed that may be claimed to lead to "better" decisions. A "soft" concept of consensus is assumed, in the sense of Kacprzyk and Fedrizzi (1987 - …) meant as a degree to which, e.g., "most of relevant agents agree as to their preferences (or other testimonies as, e.g., ordering of options) as to almost all crucial options". The fuzzy majority, equated with linguistic quantifiers, is dealt with using the classic Zadeh's calculus, OWA operators, etc.

As usually, we mean consensus as a state of agreement in a group, as a way to reach consensus in the sense of time evolution of changes of the agents' testimonies, and also as a way decision making should proceed in multiegent settings.

Basically, consensus decision making aims at attaining the consent, not necessarily the agreement, of agents involved account for views of all agents involved to attain a decision that will be beneficial to the group as a whole, not necessarily to the particular agents who may give consent even if this will not be their first choice but just acceptable, to offer their willingness to cooperate. Therefore, consensus reaching boils down to the cooperation as opposed to most other multiagent settings, notably voting, gaming, etc. which boil down to a competition.

Virtually all consensus reaching processes, also in our context, proceed in a multistage setting, i.e. the agent change their opinions step by step until, possibly, some consensus is reached. We assume a more realistic scenario that process is moderated (facilitated) by a moderator (a super agent), etc. who is responsible for running the consensus reaching session in question by persuading the agents to change their testimonies by rational argument, persuasion, etc. and keeping the process within a period of time considered. Basically, the moderator has to deal with the particular options and individuals.

For efficiency, the moderator should be supported by some additional information, or hints and clues. We will use here some additional indicators introduced by Kacprzyk and Zadrożny

(2005, 2010) which indicate, by using linguistic data summaries in the sense of Yager (1982) and Kacprzyk and Yager (2001) and Kacprzyk, Yager and Zadrożny (2000, Kacprzyk and Zadrożny (2005 - …), such options and agents that can be promising candidates for persuading them to change their testimonies. All these additional pieces of information can help the moderator to single out those options and agents whose changes of testimonies are particularly efficient in terms of implying a considerable change of the degree of consensus. Obviously, this most reasonable changes are usually at the expense of some options and agents whose testimonies and their potential changes are not accounted for. This is a greedy approach which may be effective and efficient from a formal point of view but not acceptable by those "neglected agents".

Such an undesirable exclusion of options and individuals in the moderator run consensus reaching process can be greatly alleviated by using a new fairness oriented approach proposed by Kacprzyk and Gołuńska (2012 - …) that adds some tools and techniques of the economic theory of equity, notably the equitable resource allocation, to formally introduce a mechanism of assuring fairness in the sense of taking into account in a fair way testimonies of all the agents involved, and all options in question. Moreover, some approach to account for the very essence of human judgments, in particular by using pro and con arguments, and human biases, notably the status quo bias and the minimum change principle is mentioned.

Some examples of benefits of the above new approach are presented.

Speaker Bio

Janusz Kacprzyk graduated from Warsaw University of Technology, Poland, with M.Sc. in automatic control and computer science, obtained in 1977 Ph.D. in systems analysis and in 1991 D.Sc. in computer science. He is Professor of Computer Science at the Systems Research Institute, Polish Academy of Sciences, and at WIT – Warsaw School of Information Technology, and Professor of Automatic Control at PIAP – Industrial Institute of Automation and Measurements. He is Honorary Foreign Professor at the Department of Mathematics, Yli Normal University, Xinjiang, China, and Visiting Scientist at RIKEN Brain Research Institute, Tokyo, Japan. He is Full Member of the Polish Academy of Sciences, Member of Academia Eureopaea (Informatics), Member of European Academy of Sciences and Arts (Technical Sciences), Foreign Member of the Spanish Royal Academy of Economic and Financial Sciences (RACEF), and Foreign Member of the Bulgarian Academy of Sciences. He is Fellow of IEEE, IFSA, EurAI (ECCAI) and SMIA.
He has been a frequent visiting professor in the USA, Italy, UK, Mexico, China, and Austria. He has been a member of evaluation commissions of many foreign universities.
His main research interests include the use of modern computation computational and artificial intelligence tools, notably fuzzy logic, in decisions, optimization, control, data analysis and data mining, with applications in databases, ICT, mobile robotics, systems modeling etc.
He authored 6 books, (co)edited more than 100 volumes, (co)authored ca. 550 papers, including ca. 80 in journals indexed by the WoS. His bibliographic data are: due to Google Scholar - citations: 21563; h-index: 66, due to Scopus: citations: 5498; h-index: 33; due to WoS: citation:
5297, h-index: 32. He is the editor in chief of 6 book series at Springer, and of 2 journals, and is on the editorial boards of ca. 40 journals. He is a member of the IEEE CIS Fellows Committee, was Chair of 2016 IEEE CIS Award Committee, was in 2011 – 2016 a member of Adcom of IEEE CIS, and was a Distinguished Lecturer of IEEE CIS.

He received many awards: 2006 IEEE CIS Pioneer Award in Fuzzy Systems, 2006 Sixth Kaufmann Prize and Gold Medal for pioneering works on soft computing in economics and management, 2007 Pioneer Award of the Silicon Valley Section of IEEE CIS for contribution in granular computing and computing in words, 2010 Award of the Polish Neural Network Society for exceptional contributions to the Polish computational intelligence community, IFSA 2013 Award for his lifetime achievements in fuzzy systems and service to the fuzzy community, and the 2014 World Automation Congress Lifetime Award for contributions in soft computing, the 2016 Award of the International Neural Network Society – Indian Chapter for Outstanding Contributions to Computational Intelligence. He is President of the Polish Operational and Systems Research Society and Past President of International Fuzzy Systems Association.