

**Proposal for a Tutorial on DSMT
at Fusion 2008 Int. Conference on Information Fusion, Cologne, Germany.
June 30- July 3, 2008.**

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1 - Basic information

Title of the tutorial : Advances and Applications of DSMT for Information Fusion

Duration : 3 hours (could be 4 hours depending on Fusion 2007 organizers - see Fusion 2007 Final report in section 6.)

Speakers : Dr. J. Dezert and Dr. F. Smarandache

Affiliations:

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DSMT Web page : <http://www.gallup.unm.edu/~smarandache/DSMT.htm>

Keywords: DSMT, Information fusion, belief functions, reasoning under uncertainty, qualitative and quantitative beliefs, conditioning, conflict management.

Objective of the proposed tutorial :

The tutorial gives an overview of the Dezert-Smarandache Theory for Plausible and Paradoxist Reasoning (DSMT), theoretical examples, and its applications in medicine, military, robotics in order to familiarize the attendees with this theory and help them to apply it in their work.

2 - Target audience

Students, engineers, professors and researchers in information fusion and target tracking, in airspace and defense industry, in medicine, and in robotics.

3 - Abstract

The combination of information is a hot topic of research specially in the development of complex systems involving imprecise, uncertain and potentially highly conflicting information/data with usually (but not necessarily) human interaction at some higher fusion level for efficient decision-making. Modern multisensor systems for tracking, classification, diagnosis, situation assessment, etc need solid theoretical tools to combine efficiently information in order to reduce as best as possible ignorances and contradictions in a coherent way to help to take proper decision. This task is very difficult and many theories (probability theory, possibility theory, Dempster-Shafer theory (DST), etc) have been proposed to deal with different kinds of uncertainties (randomness, fuzzyness, epistemic nature, etc). After a brief reminder of classical combination rules based on belief functions used up to now in most of (non Bayesian) multisensor/expert systems, a detailed presentation of foundations and advances obtained in the development of Dezert-Smarandache theory (DSmT) for the combination of uncertain, imprecise and potentially highly contradicting sources of information will be given. DSmT appears as a natural extension of DST because DSmT takes into consideration any kind of model (free, hybrid DSm models and also the classical Shafer's model) according to the integrity constraints of the fusion problem. DSmT proposes a new mathematical framework and rules for information fusion that potentially allows some intersections of elements of the frame (i.e. some degree of consensus between elements). Fusion rules developed in DSmT framework overcome limitations of Dempster's rule and its alternatives as it will be showed in very simple examples. DSmT appears well adapted to static or dynamic fusion applications represented in terms of belief functions based on the same unified general mathematical formalism. The mathematical level of this tutorial and didactic examples will be kept as simple as possible to show the advantages of this new approach over previous ones. Aside basis of DSmT, we will present the recent Proportional Conflict Redistribution (PCR5) rules and show their performances on several examples and will present also a new general arithmetic for the fusion of qualitative beliefs. An introduction to new quantitative belief conditioning rules will be also presented. A direct extension of the quantitative/numerical information fusion and conditioning rules to their quantitative counterparts in order to deal with qualitative information drawn from human sources and expressed in natural language will complete this tutorial.

4 - Detailed outline

Generalization from DST to DSmT : Construction of hyper-power set as a generalization of the power set, DSm Classic rule of combination as an extended Dempster's rule on the new fusion space; counter-examples to Dempster's rule ; alternatives to Dempster's rule ; free and hybrid models, besides Shafer's model; Other combination quantitative rules : DSm Hybrid rule (DSmH) as an extension of Dubois-Prade rule, Proportional Conflict Redistribution rule (PCR5) ; Belief Conditional Rules (BCRs) ; Generalized Pignistic Transformation (GPT) and DSm subjective Probability (DSmP) ; Discrete and continuous bba ; imprecise bba; Static and dynamic fusion; Comparison of fusion rules; Zadeh's example; Quasi-associativity; refined frame; Fusion of qualitative data ; equidistant and non-equidistant labels ; qualitative fusion rules ; Qualitative Belief Conditional Rules (QBCR) ; Applications of DSmT to : land cover change prediction, estimation of

target behavior tendencies, generalized data association for MTT in clutter, neutrosophic framework for situation analysis, multitarget tracking, robot map building and self localization from sonar sensors, image segmentation and target classification, MS particle filtering, biometric match score fusion, etc.

Bonus material : The attendees of this tutorial will receive a printed copy of the slides of the tutorial presentation and as bonus material a printed copy of the last book published by the authors entitled « Advances and Applications of DSMT for Information Fusion », Collected Works, Vol.2, Rehoboth, July 2006. The attendees are also invited to contribute papers on DSMT for the third volume ; deadline is October 31, 2008.

5 - Biographies of speakers

Jean Dezert was born in l'Hay les Roses, France, on August 25, 1962. He received the electrical engineering degree from the Ecole Française de Radioélectricité Electronique and Informatique (EFREI), Paris, in 1985, the D.E.A. degree in 1986 from the University Paris VII (Jussieu), and his Ph.D from the University Paris XI, Orsay, in 1990, all in Automatic Control and Signal Processing. During 1986-1990 he was with the Systems Department at the French Aerospace Research Lab (ONERA), Châtillon, France, and did research in multisensor multitarget tracking (MS-MTT) . During 1991-1992, he visited the Department of Electrical and Systems Engineering, University of Connecticut, Storrs, U.S.A. as an European Space Agency (ESA) Postdoctoral Research Fellow. During 1992-1993 he was teaching assistant in Electrical Engineering at the University of Orléans, France. Since 1993, he is senior research scientist in the Information Modelling and Processing Department (DTIM) at ONERA. His current research interests include autonomous navigation, estimation theory, stochastic systems theory and its applications to MS-MTT, information fusion, plausible reasoning and non-standard Logics. Dr. Jean Dezert is developing since 2001 with Professor Smarandache a new theory of plausible and paradoxical reasoning for information fusion (DSMT) and has edited two textbooks (collected works) devoted to this new emerging research field published by American Research Press, Rehoboth in 2004 and 2006 respectively. He owns one international patent in the autonomous navigation field and has published several papers in international conferences and journals. He coauthored a chapter in Multitarget-Multisensor Tracking: Applications and Advances, Vol.2 (Y. Bar-Shalom Editor). He is member of IEEE and of Eta Kappa Nu, serves as reviewer for different International Journals, taught courses on MS-MTT and Data Fusion at the French ENSTA Engineering School, collaborates for the development of the International Society of Information Fusion (ISIF) since 1998, and has served as Local Arrangements Organizer for Fusion 2000 Conference in Paris. He has been involved in the Technical Program Committees of Fusion 2001-2007 International Conferences. Since 2001, he is a member of the board of the International Society of Information Fusion (<http://www.isif.org>) and serves in ISIF executive board. He served as executive vice-president of ISIF in 2004. In 2003, he organized with Professor Smarandache, the first special session devoted to plausible and paradoxical reasoning at Fusion 2003, Cairns, Australia and also a panel discussion and a special session on DSMT at Fusion 2004, Fusion 2006. Dr. Dezert gave several invited seminars and lectures on Data Fusion and Tracking during recent past years – the last recent was given at Henri Poincaré Institute, Paris, January 22th, 2008. He also participates as member of Technical

Committee of last Fuzzy Set and Technology and Cogis Conferences. He is also Associate Editor of Journal of Advances in Information Fusion (JAIF). Recent advances on DSMT can be found on DSMT web page.

Florentin Smarandache was born in Balcesti (Valcea), Romania, in 1954. He got a M. Sc. Degree in both Mathematics and Computer Science from the University of Craiova in 1979, received a Ph. D. in Mathematics from the Moldova State University at Kishinev in 1997, and continued postdoctoral studies at various American Universities (New Mexico State University in Las Cruces, Los Alamos National Laboratory) after emigration. In 1988 he escaped from his country, pasted two years in a political refugee camp in Turkey, and in 1990 emigrated to USA . In 1996 he became an American citizen. Dr. Smarandache worked as a professor of mathematics for many years in Romania, Morocco, and United States, and between 1990-1995 as a software engineer for Honeywell, Inc., in Phoenix, Arizona. In present, he teaches mathematics at the University of New Mexico, Gallup Campus, where he is a Department Chair. Very prolific, he is the author, co-author, and editor of 75 books, over 100 scientific notes and articles, and contributed to about 50 scientific and 100 literary journals from around the world (in mathematics, informatics, physics, philosophy, rebus, literature, and arts). He wrote in Romanian, French, and English. Some of his work was translated into Spanish, German, Portuguese, Italian, Dutch, Arabic, Esperanto, Swedish, Farsi, Arabic, Chinese. He was so attracted by contradictions that, in 1980s, he set up the "Paradoxism" avant-garde movement in literature, philosophy, art, even science, which made many advocates in the world, and it's based on excessive use of antitheses, antinomies, paradoxes in creation - making an interesting connection between mathematics, engineering, philosophy, and literature and led him to coining the neutrosophic logic, a logic generalizing the intuitionistic fuzzy logic that is able to deal with paradoxes. In mathematics there are several entries named smarandache geometries, smarandache algebraic structures, and especially paradoxes in international journals and encyclopedias. He organized the 'First International Conference on Neutrosophics' at the University of New Mexico, 1-3 December 2001. Small contributions he had in physics and psychology too. Much of his work is held in "The Florentin Smarandache Papers" Special Collections at the Arizona State University, Tempe, and Texas State University, Austin (USA), also in the National Archives (Rm. Vâlcea) and Romanian Literary Museum (Bucharest), and in the Musée de Bergerac (France). In 2003, he co-organized with Dr. Jean Dezert, the first special session devoted to plausible and paradoxist reasoning for information fusion at the Fusion 2003 in Cairns, Australia, and has participated to several international workshop and seminar on Information Fusion since 2003.

F. Smarandache & J. Dezert edited two books devoted to DSMT-based Information Fusion in 2004 and 2006 respectively.

The complete list of references and past seminars and workshop on DSMT can be found on the above DSMT web page for your convenience.