

Title of the tutorial	Information fusion and decision-making support with belief functions
Organisers contact details <i>name, email address, affiliation</i>	<p>Jean Dezert, Ph.D, Maître de Recherches The French Aerospace Lab (ONERA), DTIM, F-91761 Palaiseau, France. jean.dezert@onera.fr,jdezert@gmail.com</p> <p>Deqiang Han, Ph.D, Professor Xi'an Jiaotong University, Xi'an, China 710049 dqhan@gmail.com</p>
Duration of tutorial <i>Half day or full day</i>	4 hours (Half day)
Keywords, and scope or objectives	<p>This tutorial presents the state-of-the-art of information fusion approaches based on belief functions (BF) for combining qualitative or quantitative, imprecise, uncertain sources of evidences, and for mono or multi-criteria decision-making support.</p> <p>Keywords: Belief functions (BF), Conflict management, Decision-Making under uncertainty, Multi-Criteria Decision-Making (MCDM), Dempster-Shafer Theory (DST), Dezert-Smarandache Theory (DSmT)</p>
Target audience	<p>Students, engineers, professors and researchers requiring high advanced tools for information fusion and decision-making under uncertainty useful in aerospace and defense industry, in medicine, in robotics, etc.</p> <p>Prerequisites for the background knowledge of the attendees: Basic skills in math and probability theory.</p>
Abstract <i>A brief description of the tutorial, suitable for inclusion in the conference registration brochure</i>	<p>The combination of qualitative or quantitative, imprecise, uncertain sources of evidences information is of main interest especially in the development of complex systems that have to deal with uncertainties and highly conflicting information/data with usually (but not necessarily) human interaction at some higher fusion level for efficient decision-making. This task is very difficult in general and many theories have been developed to deal with different kinds of uncertainties (randomness, fuzziness, epistemic nature, etc.), like probability theory, possibility theory, and belief functions theories (DST, TBM, DSmT), etc. In this tutorial we concentrate on the presentation of belief functions starting from Shafer's original idea up to the most recent developments proposed by Dezert and Smarandache. We will show through different examples the limits of DST and how the problems can be circumvented with DSmT and also the limitations of DSmT. The mathematical level of this tutorial and of the didactic examples chosen will be kept as simple as possible to be easily understood by all attendees, and specially those not familiar with belief functions. Aside the presentation of belief functions and their use with advanced techniques, we also present different methods for decision-making under uncertainty based on belief functions. Both aspects of decision-making (mono-criterion and multi-criteria) will be presented.</p>
Detailed outline	The topic of this tutorial fits with the main concerns of Fusion 2017 conference and will present classical techniques to fuse information when

This should address the following:

Why the topic is of interest for FUSION 2010 attendees and the expected benefit to the participant, depth and scope of the exposed topics, exercises, software demonstrations etc.

they are uncertain, imprecise, possibly conflicting, quantitative and qualitative and arising from different sources having their own reliability and importance in the fusion process. The tutorial will cover the following points:

Belief functions and DST: History, ignorance and probabilities, definitions of BF, discounting, conflict, combination of BF, pros and cons of Dempster's rule, counter-examples with high and low conflict situations, numerical robustness, conditioning, other rules.

DSmT and PCR rules: motivations, definitions and models, importance and reliability discountings, Proportional conflict redistribution (PCR) principles and rules, pros and cons, extension to qualitative and imprecise belief functions, complexity and sampling techniques for combination.

Decision-making support with BF (mono and multicriteria): From BF to subjective probabilities, distances between BF, decisional attitudes. Extensions of OWA (Ordered Weighted Averaging), of AHP (Analytic Hierachy Process), and TOPSIS methods for MCDM with BF.

Applications of advanced techniques with BF: Non exhaustive list of applications working with advanced techniques using BF with references.

Material provided: copy of tutorials (in printed and pdf versions)

Complementary information:

<http://www.onera.fr/staff/jean-dezert?page=2>

<http://www.onera.fr/staff/jean-dezert?page=3>

Tutors biography

A brief resume of the organiser(s), highlighting the background in the proposed special session area.

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 Modeling 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. Jean Dezert developed with Professor Smarandache a new theory of plausible and paradoxical reasoning for information fusion based on extensions of belief functions (known as DSmT) and has edited four textbooks (collected works) devoted to this theory. He owns one international patent in the autonomous navigation field and has around 200 papers in international conferences and journals. He is 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 most of ISIF Fusion International Conferences. From 2001 to 2009, he served in the executive board of the International Society of Information Fusion (<http://www.isif.org>). He served as executive vice-president of ISIF in 2004 and was President of ISIF in 2016. Dr. Dezert gave several invited seminars and lectures on Information Fusion and Tracking in Europe, U.S.A, Canada, Australia and China.

Web page: <http://www.onera.fr/staff/jean-dezert>

Deqiang Han (was born in Xi'an, China, in 1980. He received the bachelor's degree in Communication and Control Engineering and the master's and Ph.D. degrees in Control Science and Engineering from Xi'an Jiaotong University, Xi'an, in 2001, 2004, and 2008, respectively. He is Professor with Xi'an Jiaotong University. His current research interests include evidence theory, information fusion, and pattern classification. Prof. Han is an International Society of Information Fusion (ISIF) Member and Technical Program Committee Member for the 1st–7th Chinese Conference on Information Fusion in 2009–2015, He is Secretary and Co-organizer of ISIF Fusion 2017 conference in Xi'an.