Posters Abstracts

7th School on Belief Functions and their Applications

Oct. 19-23, 2025, Granada, Spain

Session 1

Monday, 20 October 2025, 16:00 – 17:15

Abdelhak Benamirouche

Abdelhak Benamirouche, IRIMAS, Université de Haute-Alsace

Abstract: Robust perception in autonomous driving remains a major challenge due to environmental degradations such as fog, rain, and low lighting, which affect the performance of sensors like cameras, LiDAR, and radar. While multimodal fusion offers a way to combine their complementary strengths, most traditional approaches assume uniform sensor reliability, overlooking the fact that each modality's trustworthiness varies depending on the semantic content and external conditions. This PhD work addresses this issue by proposing an adaptive multimodal fusion framework that accounts for both sensor reliability and inter-modality inconsistencies. The approach involves estimating the reliability of each sensor according to the semantic context and visibility conditions, and integrating this knowledge into a fusion process rooted in belief function theory and evidential neural networks. Preliminary experiments on real and synthetic driving datasets under varying weather and sensor degradation scenarios demonstrate improved segmentation performance and robustness. These results support the thesis goal: enabling autonomous vehicles to make robust decisions, even when operating with partially degraded sensor inputs.

David Nieto Barba

Distorting lower probabilities using common distortion models

David Nieto Barba, University of Oviedo

Abstract: Distortion or neighbourhood models are useful tools in the imprecise probability theory allowing to robustify a probabilistic model by considering a neighbourhood around a given probability measure. In this work, we tackle the more general problem of distorting a lower probability. This problem can be interesting when we believe that a given lower probability is too precise, or in coalitional game theory when the credal set of the lower probability, that represent the solutions of the game satisfying the requirements of the coalitions, is empty. Our main purpose is to investigate how the linear vacuous and pari mutuel models can be defined for the distortion of lower probabilities, and for this aim we address the problem in a more general manner: extending the vertical barrier model, that includes the linear vacuous and pari mutuel as particular cases, and investigating the properties they satisfy.

Juan Jesús Salamanca Jurado

Axiomatic approach to aggregation of lower previsions
Juan Jesús Salamanca Jurado, University of Oviedo

Abstract: Lower previsions can be interpreted as uncertainty probability laws. In many situations, the problem is to aggregate several lower previsions into another representative one. As different procedures can be proposed, it is necessary an axiomatic approach to select a proper one. In this work we review the main axioms required to such an aggregation procedure. We analize the relationships between those axioms. Then, for each of the main aggregation found in the literature, we examine whether satisfies each axiom. Finally, we provide general considerations to give the practitioner reasons to select one or another aggregation rule. This work is based on the paper:

[1] A comparative analysis of aggregation rules for coherent lower previsions, E. Miranda, J.J. Salamanca, I. Montes, International Journal of Approximate Reasoning, 109474.

Kudzai Sauka

Kudzai Sauka, Amsterdam University of Applied Sciences

Abstract: We propose a Dempster–Shafer Theory (DST)-based framework for intent classification in task-oriented dialogue systems with hierarchical intent taxonomies. Our method operates on top of a base, assigning mass functions to intents. When the most specific intent cannot be confidently identified, the system issues clarification ques- tions (CQs) to disambiguate among candidates. Responses are incor- porated using a modified Dempster's rule, enabling iterative belief refinement. This approach provides a principled criterion for both when to ask CQs and how to integrate user responses. Experiments with base classifiers across multiple datasets show consistent gains in prediction accuracy over the base classifier, with only a small number of CQs per instance.

Marina Iturrate-Bobes

How do normality tests behave for rounded data?
Marina Iturrate-Bobes, University of Oviedo

Abstract: Most statistical inference techniques are built assuming the existence of a continuous random variable that should be measured repeatedly. However, there are situations in which the imprecision inherent to the data collection process affects the results. For instance, this occurs in the presence of censored data, missing data, or when the data is rounded. In all these cases, the results of statistical tests might be compromised. As one such example, we tackle the problem considered in [5,6] of testing for normality with rounded data, considering here the perspective of imprecise probabilities. More specifically, we provide a theoretical framework and perform and empirical study for such a problem. For this aim, we take the following steps:

Step 1 Mathematical formalisation: We formalise the problem using random sets [1]. Assuming that the continuous random variable of interest is rounded to the d-th decimal number ($d \in \mathbb{Z}$), where d¡=0 means rounding to the (1-d)-th digit to the left of the decimal point, we define the set $\mathbb{Z}_d = \{x \mid 10^d \cdot x \in \mathbb{Z}\}$. Hence, we consider a random set $\tilde{X}$ such that for any element ω in the possibility space it holds that $\tilde{X}(\omega) = \left[z - 5 \cdot 10^{-(d+1)}, z + 5 \cdot 10^{-(d+1)}\right)$ for some $z \in \mathbb{Z}_d$. For example, if data is rounded to the second decimal number (i.e., $d = 2$) and for some ω it holds that $X(\omega) = 1.7428$, we will observe the rounded value 1.74. This rounded value might appear after rounding any value in the interval $\tilde{X}(\omega) = [1.735, 1.745)$. In this framework, all we know

about the "real" rounded random variable X is that it is one of the measurable selections of $\tilde{X}$.

Step 2 Tests under imprecision: In statistical testing, a hypothesis test determines the acceptance region and the critical region. However, when the data is subject to imprecision, according to [2] a third region, called the indecision region, naturally appears, and it is formed by those random samples for which the imprecision prevents from making a decision.

Step 3 Normality tests: Many normality tests can be found in the literature; some of them are reviewed in [4] where a comparative study of their power is performed. For these tests, the power does not depend on the mean or the standard deviation of the population. In our setting, we analyse whether, when applied to rounded data, the tests become sensitive to these population parameters.

Step 4 Empirical analysis of the power: An empirical analysis is performed to (i) examine how the power varies when varying the decimal number at which the data is rounded, and (ii) compare the performance of different normality tests in the presence of imprecision.

After following these steps, we will show how random sets allow us to formalise the imprecision caused by rounding in order to have a full picture of how normality tests behave under such imprecision. For future research, we will explore the approach to goodness-of-fit tests proposed in [3], where the Kolmogorov-Smirnov test was expanded to interval-data by using p-boxes. More precisely, we will look for a link between the approach based on random sets and the approach based on p-boxes when testing for normality with rounded data.

References:

[1] I. Couso, D. Dubois, and L. Sánchez. Random Sets and Random Fuzzy Sets as Ill-Perceived Random Variables. Springer Briefs in Applied Sciences and Technology. Springer, 2014.

[2] I. Couso and L. Sánchez. "Mark-recapture techniques in statistical tests for imprecise data". In: International Journal of Approximate Reasoning 52 (2011), pp. 240–260.

[3] S. Destercke and O. Strauss. "Kolmogorov-Smirnov Test for Interval Data". In: Information Processing and Management of Uncertainty in

Knowledge-Based Systems. Ed. by A. Laurent et al. Springer, 2014, pp. 416–425.

[4] N. Razali and Y.B. Wah. “Power comparisons of Shapiro–Wilk, Kolmogorov–Smirnov, Lilliefors and Anderson–Darling tests”. In: Journal of Statistical Modeling and Analytics 2.1 (2011), pp. 21–33.

[5] A.R. Tricker. “The effect of rounding on the power level of certain normal test statistics”. In: Journal of Applied Statistics 17.2 (1990), pp. 219–228.

[6] A.R. Tricker. “The effect of rounding on the significance level of certain normal test statistics”. In: Journal of Applied Statistics 17.1 (1990), pp. 31–38.

Rafael Cabañas de Paz

Rafael Cabañas de Paz, University of Almería

Abstract: Causality is currently an emerging direction in data science, offering numerous potential applications in various domains such as Artificial Intelligence, Economics, Social Science, and Medicine. Causal inference enables reasoning about hypothetical scenarios; for example, in a medical trial, it could involve estimating the probability of recovery for a deceased patient had they received a different treatment. Pearl’s structural causal models (SCMs) represent a popular formalism for causality. These models consist of endogenous (manifest) and exogenous (usually latent) variables, with the endogenous values determined from the exogenous ones through structural equations. Often, the exogenous probabilities in an SCM are unavailable due to insufficient data for these variables. Consequently, many causal and counterfactual queries are unidentifiable and cannot be calculated by standard inference algorithms for Bayesian networks. Recently, various methods have been proposed for bounding such queries, treating it as a problem of learning Probabilistic Graphical Models (PGMs) with latent variables.

Ruolan Cheng

Fourier Transform of basic probability assignment
Ruolan Cheng, University of Granada

Abstract: Abstract: The Fourier transform plays a crucial role in the frequency-domain analysis. In probability theory, the Fourier transform of a probability distribution, known as the characteristic function, has been extensively studied and applied. As a generalization of the probability distribution, the basic probability assignment (BPA) in Dempster-Shafer theory (DST) models uncertainty by assigning belief masses to the power set of basic events. However, there is still no relevant research involving the frequency-domain perspective of such power set information distribution. To address this research gap, this paper conducts the first exploration of the Fourier transform in DST. A Fourier transform method for BPA is proposed, and its theoretical properties are rigorously examined, including proofs of uniform continuity, positive semi-definiteness, and uniqueness theorems. Some numerical examples are presented to visualize the BPAs in the frequency domain, and the statistical nature of their moments is further analyzed. The proposed Fourier transform can not only degenerate into the characteristic function by setting specific frequency parameters, but also reveal a correspondence with the commonality and implicability function. It enables the four combination rules in DST to be implemented in the frequency domain, thereby opening a new avenue for processing and updating uncertain information.