

**19th Workshop: Noncommutative Probability, Noncommutative Harmonic Analysis  
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**ABSTRACT**

Adrián Celestino (Norwegian University of Science and Technology)

**Forest formulas and relations between cumulants**

**Abstract:** Relations between moments and cumulants play a central role in the combinatorial study of non-commutative probability theory. Arizmendi and his collaborators have studied in [1] relations among classical, free, Boolean and monotone cumulants using the common approach based on Möbius inversion and other combinatorial and algebraic techniques. Later, by using the Hopf algebraic framework for non-commutative probability developed by Ebrahimi-Fard and Patras, the picture was augmented by providing the multivariate formulas that write monotone cumulants in terms of free and Boolean cumulants. On the other hand, forest formulas that generalize Zimmermann's forest formula in quantum field theory have been obtained for the computation of the antipode in the dual of enveloping algebras of pre-Lie algebras. In this talk, I will explain how to derive the relations between monotone and free (Boolean) cumulants by applying forest formulas to a certain pre-Lie algebra of words. This is a joint work with Frédéric Patras ([2]).

- [1] Arizmendi, O., Hasebe, T., Lehner, F., & Vargas, C. (2015). Relations between cumulants in noncommutative probability. *Advances in Mathematics*, 282, 56-92.
- [2] Celestino, A., & Patras, F. (2022). A forest formula for pre-Lie exponentials, Magnus' operator and cumulant-cumulant relations. *arXiv preprint arXiv:2203.11968*.