



## Statistics Seminar Series

Session 2, 2006



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**Lukasz Debowski**

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### Ergodic decomposition of excess entropy

Motivated by linguistic applications, we shall discuss excess entropy defined as mutual information between the past and future of a stationary process. Our main result is an ergodic decomposition of the following form: Excess entropy is the sum of self-information of shift-invariant  $\sigma$ -field and the average of excess entropies for the ergodic components of the process. The result is derived using generalized conditional mutual information for fields of events, for which we have developed a simple approach.

A corollary of this ergodic decomposition is that excess entropy is infinite for the class of processes with uncountably many ergodic components, called here uncountable description processes (UDPs). UDPs can be characterized without the use of measure theory and we argue for their potential utility in linguistics.

Moreover, we shall apply the ergodic decomposition of excess entropy to a setting which is close to the problem of redundancy rates: Firstly, we will show that finite-order excess entropies (defined as mutual information between finite blocks) are dominated by the expected excess lengths of any universal code. Secondly, we will prove that the expected excess code lengths diverge to infinity for all codes and almost every stationary process.

**About the speaker:** Lukasz Debowski works at the Institute of Computer Science, Polish Academy of Sciences. His research interests relate to the interface between probability theory and linguistics, including information theory (excess entropy), statistical natural language processing (machine learning), and quantitative linguistics.

**Time:** 4pm, Friday, 25th August

**Location:** Room 4082, Red Centre

Please join us after the seminar for wine and cheese in the staffroom.

Seminar co-ordinator: Sally Galbraith

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