PROBABILITY AND INFORMATION THEORY

Cele kształcenia

The aim of this lecture is to provide students with specific knowledge of probability theory and statistics necessary to understand some aspects of quantum mechanics and quantum information theory. The student will also acquire basic knowledge in the field of application of the main concepts of

information theory such as entropy, mutual information or relative entropy and their properties. The student will also learn the capacities of communication channels and methods of estimating them. Acquiring this knowledge will result in understanding of the possibilities and limitations of communication as well as will provide an introduction to other courses of quantum information theory. The student will be able to apply the knowledge learned in whatever context it can be used, including physics, statistics and cryptography.

Wymagania

Basic knowledge of mathematics at high school level is required

Treści programowe

Lecture and excersises will cover the same main topics.

1. Basic notions of probability: probability space, standard normal distribution, random variable, expected value, variance.
2. Density function and the cumulative distribution function, independence of random variables.
3. Bayes theorem.
4. Law of large numbers and the central limit theorem for indenepent and identically distributed random variables.
5. Shannon entropy function, its interpretation and properties.
6. Entropy functions of many variables, including conditional entropy, mutual information, relative entropy, conditional mutual information and their properties, including data processing inequality and the chain principle for conditional mutual information.
7. Asymptotic Equipartition Property theorem, compression codes , error correction codes.
8. The concept of typical and total typical sequences, Shannon's theorem on the capacity of a communication channel, random code technique.
9. Capacities of selected communication channel and Slepian-Wolf theorem on joint coding.
10. Kraft and Mc Millan inequality

Wykaz literatury

- A. Literature required to pass the course
- E. Shannon, W. Weaver “ The Mathematical Theory of Communication”
- Thomas M. Cover, Joy A. Thomas “Elements of Information theory”
- R. W. Yeung “A First Course in Information Theory”
- chapters of M. Nielsen, I. Chuang „Quantum Information and Computation” concerning IT
- B. Extracurricular readings
- other chapters of M. Nielsen, I. Chuang „Quantum Information and Computation”