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Title: Towards spatial systems biology using imaging mass spectrometry

Abstract: Imaging mass spectrometry (imaging MS) has emerged in the last decade as a label-free, spatially-resolved, and multi-purpose bioanalytical technique for direct analysis of biological samples from animal tissue, plant tissue, biofilms, and polymer films. The impressive technological progress and increasing availability of the advanced instrumentation and supporting software promoted this technique in various areas of biology and led to an increased excitement reaching beyond the field of mass spectrometry.

After a decade of collective efforts, imaging MS became an analytical technique of choice to be a cornerstone for creating the spatial systems biology at the levels of cell populations, organ, and organism. This challenging goal requires developing novel and efficient algorithms for analysis of large data provided by imaging MS and interpretation of this data in light of molecular knowledge as well as integration of imaging MS data with existing molecular knowledge bases.

In this talk, I will present our first steps on the way to creating spatial systems biology using imaging MS. I will outline possible applications, highlight the challenges, and present recent research results. I will show molecular maps of the skin surface of a human and how they are related to distribution of microbial communities on the skin or influenced by environmental factors. I will demonstrate how imaging MS can be used to understand molecular composition of mammalian organs and how data mining can be performed extracting and interpreting molecular signals for regions of pathological interest. At last, I will present algorithms enabling interpretation of this large hyperspectral 2D and 3D data in light of existing molecular knowledge.

Short biography: Theodore Alexandrov received a PhD in mathematics in Russia, did his postdoc at University of Bremen, Germany, where he became a group leader at the Center for Industrial Mathematics and the head of MALDI Imaging Lab. Since 2010, he is the scientific director of the company SCiLS and a visiting researcher at University of California San Diego. Starting from October, he is a team leader at European Molecular Biology Laboratory in Heidelberg with a research program on spatial metabolomics.