COURSE ANNOUNCEMENT:
APPLIED ALGEBRAIC GEOMETRY (FALL 2016)

Course title: Applied Algebraic Geometry

Lecturer: Prof.dr.ir. Jan Draisma (jan.draisma@math.unibe.ch)

Dates and venue: Thursdays, 10-12h (actually, lectures start at 10:15), room B77 (ExWi, Sidlerstrasse 5, 3012 Bern). Start: Thursday, September 22, 2016.

Topics: Over the last decades, algebraic geometry has started to interact with applications at an ever-increasing pace. The interaction goes both ways: existing algebro-geometric techniques are applied to practical problems, and conversely, applications lead to interesting, new, algebro-geometric questions. In this CUSO course we will explore a number of these interactions in some detail, where the emphasis is on the algebro-geometric questions rather than real-life applications. It is a *topics course* rather than a course leading up to any single major theorem—many beautiful results will be covered!

Specifically, we will study aspects of

- **Tensor decomposition:** here the goal is to express a general tensor as sum of a small number of low-complexity tensors. This goal leads to questions of identifiability (is the decomposition unique?), equations for strata of low-rank tensors, etc.
- **Algebraic statistics:** many statistical models can be described by means of polynomial equations, and statistical questions like finding maximum-likelihood estimates then become amenable to algebraic techniques.
- **Polynomial optimisation:** here the problem is finding the extreme values of a polynomial function on a set given by polynomial equations. Numerous optimisation problems can be formulated in this manner.

There are several interconnections between these topics. Along the lines, I will also discuss computational aspects, both using classical symbolic algorithms (Gröbner bases) and using more recent algorithms for numerical algebraic geometry.

Prerequisites: Basic notions and results from algebraic geometry and commutative algebra (such as polynomial ideals, Hilbert's basis theorem and Nullstellensatz, affine and projective varieties, dimension). Knowledge of computational aspects is not assumed; they will be dealt where needed.

Literature: Rather than using a single book, most of my material will come from a number of influential papers that have appeared in the last two decades. Brief outlines of each week's topics will be made available online after each lecture.

Credits: 3ECTS.