Elimination Theory in the 21st century
Carlos D'Andrea (Universitat de Barcelona)

This century finds Computational Algebraic Geometry more in demand for applications and implementations, hence "faster" and more tailored methods to perform elimination are explored. I will survey on more compact kind of resultants that have appeared in the last decades (parametric, residual, determinantal,...), and also other types of tools like Elimination matrices, Rees Algebras and homotopy methods.

Algebraic methods for the study of biochemical reaction networks
Alicia Dickenstein (Universidad de Buenos Aires)

In recent years, techniques from computational and real algebraic geometry have been successfully used to address mathematical challenges in systems biology. The algebraic theory of chemical reaction systems aims to understand their dynamic behavior by taking advantage of the inherent algebraic structure in the kinetic equations, and does not need a priori determination of the parameters, which can be theoretically or practically impossible.

I will describe general results based on the network structure. In particular, I will explain a general framework for biological systems, called MESSI systems, that describe Modifications of type Enzyme-Substrate or Swap with Intermediates, and include many post-translational modification networks. I will also outline recent methods to address the important question of multistationarity.

Applications of Sampling in Numerical Algebraic Geometry
Jonathan Hauenstein (University of Notre Dame)

The central data structure to represent a variety in numerical algebraic geometry is a witness set. From a witness set, one is able to move the corresponding linear slice to sample points on the variety. This talk will explore several recent methods in numerical algebraic geometry that have been developed using the ability to sample points. Some highlights include new approaches for solving semidefinite programs in optimization, deciding algebraic and topological properties of a variety, and computing real points on the variety. This talk will conclude by turning this computation around to use sampling with the aim of constructing a witness set which permits one to statistically estimate the degree of a variety when it is too large to compute directly. Examples will be used to demonstrate all of these methods.

Rees algebras, syzygies, and computational geometry
Hal Schenck (Iowa State University)

Rees and symmetric algebras are fundamental topics in commutative algebra, and have recently entered the toolkit of computational geometers. This talk will begin with an overview of the basic machinery. Then we'll introduce and develop some of the more specialized tools used in the area, including Fitting ideals, the determinant of a complex, approximation complexes, and the McRae invariant. We'll focus on applying these tools to several examples of interest in geometric modeling. The only knowledge that will be assumed is that gleaned from attendance at the morning talks.

Polynomial methods and rigidity theory
Jessica Sidman (Mount Holyoke College)

In combinatorial rigidity theory linearized constraint equations are used to study a generic framework associated to a given graph G. In this setting, White and Whiteley defined a "pure condition," a polynomial that vanishes for embeddings of G that are "special" or singular. This circle of ideas generalizes to other frameworks, including systems of constraints that arise in common CAD software packages.

Returning to bar-and-joint frameworks, I will contrast polynomial methods with the linear-combinatorial ones. In particular, I will discuss rigidity of a framework in terms of various algebraic matroids associated to it.