Similarity solutions for coagulation equations with source terms. Theoretical and numerical approaches.

Claudia D. Calin  
*University of Alberta*

In this talk I will present a few theoretical and numerical results for the coagulation equations that describe the evolution of the size distribution function of a system of particles with source terms. I will consider two generalized methods that determine similarity or group invariant solutions for these equations. The first is a group symmetry method applied to a partial differential equation associated with the coagulation equation. This method determines a one-parameter local Lie group of point transformations that leaves the PDE invariant. The second method is a new generalized version of the direct methods that determine the symmetry group of point transformations to integro-differential equations. I will show how I applied this second method directly to the coagulation equation. The advantage over previous methods is that in some special cases the expression of the total mass of particles does not need to be known in advance. I will present the expression that I obtained for the total mass of particles and refer to the occurrence of the gelation phenomenon. Each of these two methods yields new similarity solutions to the coagulation equations. For some particular initial size distributions, these solutions become analytical solutions to the coagulation equation. In addition, I will describe the asymptotic behavior of such solutions at large particle sizes for a few special classes of initial distributions and bilinear, time-dependent coagulation kernels. These asymptotic solutions have been further used for numerical studies to improve the direct discretization method. Finally, I will present a new proof for the uniqueness of solutions to the coagulation equations with source terms in the case when the rate of coagulation of particles is a non-homogeneous and separable function.