Decomposition techniques such as atomic, molecular, wavelet and wave-packet expansions provide a multi-scale refinement of Fourier analysis and exploit a rather simple concept: “waves with very different frequencies are almost invisible to each other.” Starting with the classical Calderón-Zygmund and Littlewood-Paley decompositions, many of these useful techniques have been developed around the study of singular integral operators. By breaking an operator or splitting the function on which it acts into non-interacting pieces, these tools capture subtle cancelations and quantify properties of an operator in terms of norm estimates in function spaces. This type of analysis has been extensively used to study linear operators with tremendous success.

A similar but more delicate analysis can be applied to multilinear operators that arise in the study of (para)product-like operations, commutators, and other nonlinear functional expressions. In this talk, we will introduce basic concepts about decomposition techniques and focus then on a few selected aspects of a still emerging theory of multilinear singular integrals. We will present some recent results about bilinear pseudodifferential operators acting on Lebesgue and Sobolev spaces, new multilinear maximal functions and other related topics. We will discuss both similarities with the theory of linear singular integrals as well as new phenomena occurring in the multilinear setting.

Rodolfo Torres, February 19, 2010