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**Eric T Gehrig\*** (etgehri@msn.com), 1905 E University Dr R128, Tempe, AZ 85281. *Hopf Algebras and Projection Maps in Control Theory.*

Formal Power series expansions have long played a roll in dynamical systems. In particular, Magnus and Chen-Fliess expansions have been used to describe controlled dynamical systems. Such series expansions can be nicely described in terms of the combinatorics of words and Hopf algebras. Both the composition of partial differential operators and their coefficients, iterated integrals of the controls, have simple formulae in terms of combinatorics. The former in terms of a free Lie algebra and Hall sets, and the latter in terms of recursively defined Zinbiel products. A possibly more natural product is the shuffle product, the symmetrization of the Zinbiel product. Using the Hopf algebra structures present in the concatenation and shuffle algebras, this talk will present the relationship between the coordinates of the second kind, the coefficients of the directed product expansion of a controlled system of differential equations, and the coordinates of the first kind. The coordinates of the first kind are coordinates in the exponential of an infinite series derived from the Chen-Fliess series. These coordinates of the first kind are proven to be projections of the coordinates of the second kind using maps dual to the canonical projection maps of the concatenation algebra. (Received March 12, 2008)