1107-93-144 **W. Steven Gray*** (sgray@odu.edu), 231 Kaufman Hall, ECE Department, Old Dominion University, Norfolk, VA 23529. *Combinatorial algebras for iterated integrals in nonlinear control theory.*

In nonlinear control theory, input-output systems are interconnected in different ways to form more complex systems found in applications. Normally, each component system is described by a Chen-Fliess functional series expansion, that is, a weighted sum of iterated integrals which can be uniquely represented by a formal power series over a noncommutative alphabet. System interconnections are then characterized in terms of various products of these formal power series. The goal here is to present the underlying combinatorial algebras used to characterize the basic system interconnections found in control theory: the parallel, product, cascade and feedback connections. The feedback connection is perhaps the most interesting case as it is recursive in nature, and the underlying algebraic framework is that of a Faà di Bruno type Hopf algebra involving the composition of iterated integrals. The antipode of this algebra provides a recursive, cancellation-free algorithm for performing system inversion, which is a prerequisite for solving classical control problems such as output tracking and path planning. (Received January 11, 2015)