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Misha Kilmer and **Carla D Martin*** (martincd@jmu.edu), Department of Mathematics & Statistics, MSC 1911, James Madison University, Harrisonburg, VA 22807. *Factorization Strategies for Tensors*.

Operations with tensors, or multiway arrays, have become increasingly prevalent in recent years. Traditionally, tensors are represented or decomposed as a sum of rank-1 outer products. Such decompositions are motivated by specific applications where the goal is to find an approximate such representation for a given multiway array. The specifics of the approximate representation depend on the application.

In this talk, we explore an alternate representation of tensors which shows promise with respect to the tensor approximation problem. Specifically, we explore a new type of representation of tensors as products of tensors which is reminiscent of matrix factorization methods. In order to introduce this new notion, we define tensor-tensor multiplication in such a way so that it is closed under this operation. This new multiplication allows us to introduce concepts such as tensor transpose, inverse, and identity, which lead to a notion of an orthogonal tensor. Our definitions are derived for order three tensors, but have the advantage they can be extended to the order- p $p > 3$ case. A major motivation for considering this new type of tensor multiplication is to devise new types of factorizations for tensors which can then be used in applications. (Received September 23, 2009)