RESEARCH SPOTLIGHTS

Tensors, or multiway arrays, are often used for storage of high-dimensional data. In order to have compression, completion, or interpretation of such data, the data tensor is factored according to a proposed model consistent with some belief about the data. The first Research Spotlights article, "Generalized Canonical Polyadic Tensor Decomposition," by David Hong, Tamara G. Kolda, and Jed A. Duersch, treats the problem of finding a low-rank tensor decomposition that minimizes a cost functional defined from a componentwise loss function. The difference between the proposed generalized canonical polyadic (GCP) decomposition and the well-known CP decomposition is the flexibility in the choice of loss function, which can be tailored to reflect the appropriate statistical likelihood of a model given the data: low rankness of the tensor is enforced as a constraint. The main result of the paper is in Theorem 3, which addresses the computation of the gradients of a cost function defined in terms of any loss function that is continuously differentiable with respect to its second argument. Their result reveals an elegant expression for the gradients that enables the use of existing kernels for finding CP decompositions to be employed in their algorithm to compute the GCP. The authors use extensive numerical testing, highlighting the flexibility of their algorithm and its ability to efficiently handle missing data while simultaneously illustrating the potential gain to the data analyst in choosing loss functions more consistent with the data. A variety of applications are considered, including analysis of a chat network and explaining factors for mouse neural activity.

A "sticky" diffusion process, as defined in the second Research Spotlights article, "Sticky Brownian Motion and Its Numerical Solution," refers to solutions to stochastic differential equations (SDEs) that can spend finite time on a lower-dimensional boundary. Materials like concrete, paint, and toothpaste have something in common: in the limit, the dynamics of the collection of mesoscale particles of which each is comprised approaches a sticky diffusion process. Sticky Brownian motion (SBM), the simplest example of a sticky diffusion process, is the primary focus of the present work. The goals of authors Nawaf Bou-Rabee and Miranda C. Holmes-Cerfon are to call the attention of the greater applied mathematics community to the topic of sticky diffusions as well as to offer a numerical method to allow for simulation of a sticky diffusion with a relatively large time step. These goals are evident in the presentation of material. The mathematical setup of an SBM is given in section 2. Beginning with the Brownian dynamics equations and assumptions on the potential energy function, the dynamics of the probability density are discussed, including asymptotic behavior in the "sticky limit." The authors discuss how to find the generator of the SBM and give some examples. The generator is the basis for the numerical method they develop in section 3, which the authors claim is orders of magnitude faster than alternative methods to simulate a sticky Brownian motion. The authors complement their presentation with a mathematical literature review of some additional methods for characterizing SBM. The final section serves as a well-considered road map for the reader interested in extending this work to a higher-dimensional setting.

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