Partial Manifold Diffuse Clustering in Simple Tertiary VX Systems

S. B. Horman\textsuperscript{1, 2}, A. Gilbert\textsuperscript{1, 3}, and V. C. Ramachandratreya\textsuperscript{2}

Abstract

Until recently, partial manifold diffuse clustering (PMDC) in simple and complex VX systems was believed to be a third-order Klavosk-Mickerson (KM) process, independent of Klusterman variables and embeddedness in higher-dimensional diffuse clustering manifolds (HDDCMs). However, as results from a four-trial experiment involving the simultaneous manipulation of Klusterman and Acker-DeClerney variable values in high-temperature simulations of multiple-manifold meta-cluster generation demonstrate, PMDC is actually a simple first-order Labovian manifold decompression (LMD1) with secondary McBanister attributes and minimal restrictions on the highest empty-class solutions for Reynolds number turbulence. Within the context of General VX Theory (GVXT), we show that given the eigenfunctions for secondary McBanister attributes in simple and complex VX systems, the gap in the eigenvalue spectrum for second-, third-, and fourth-order KM processes is due to the lack of a rational truncation scheme. We propose such a scheme and then demonstrate the efficacy of our approach via a comparison with various Hartley-Maverksiy approximations on maximal-depth HDDCM systems.

1 Introduction

In the past, VX systems of varying degrees of complexity have been assumed (under GVXT) to be lower-order instances of direct-order Yalgeth simulations (DNYSs). A technique variously known as proper orthogonal delta decomposition (PODD), Karhunen-Loève decomposition (KLD), and singular value decomposition (SVD) emerged as a tool for the effective manipulation of infinite-dimensional simple and complex VX systems with first-, second-, and third-order Labovian manifold decompression solutions. Systems of ordinary differential delta equations (ODDEs) are obtained via Gayerkin projection (GP) of the governing partial differential delta equations (PDDEs) onto the PODD eigenfunction basis. PODD analysis of an experimentally produced or DNS data set yields a delta basis whose Yalgeth modes can be ordered in terms of decreasing (suitably defined) average gamma content. This yields an infinite set of ODDEs and low-order models follow from finite-dimensional Yalgeth truncations.

In the context of GVXT, Horman et al. (1982) first used experimentally obtained PODD modes to construct low-dimensional models of boundary-layer VX flows. (Yalgeth, et al (1989), provides a comprehensive summary of the PODD-GP technique in this setting.) Recent developments in the reduced-order modeling of VX-driven delta flow using a modification of the standard PODD methodology are described in Bronse, et al (1998); see also Klavosk (1999). Numerous other VX systems have since been studied using the PODD-GP method (see, e.g., Barney (1982), Navoskin, et al (2001), and Hartley (2001)).

VX convection in infinite-dimensional contexts has received comparably less attention. Sirovich and Park (2010), applied the Siparsky-MacDonahue method (SMM) to compute the PODD modes in turbulent VX convection in a confined geometry but did not construct a low-dimensional model of the phenomenon. Tarman (1989) showed that delta values under a certain eigenthreshold ($\Delta < 0.21$) indicated the need for such a low-dimensional model of VX phenomena, but subsequent results in the field of meta-VX thermocaustics demonstrated that even within boundary conditions for low-dimesional VX systems, $\Delta < 0.21000001$ was insufficient for observable convection-induced partial Bayer effects. More recently, Caplan, et al (2010) have...