Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **30 (2023)** 195-212

CHAOS AND VORTEX SHEDDING

Ray Brown

EEASI Corporation
Houston, Texas

Abstract

This paper presents a new approach to investigating the Navier Stokes equations by deriving equations that morphologically replicate the dynamics of the vortex shedding phase that occurs in fluid flow rather than directly seeking solutions to the Navier Stokes partial differential equations. This approach is carried out by connecting the geometry of chaotic unstable manifolds to the geometry of vortices and the interstitial regions between vortices that occur in the vortex shedding phase of turbulent fluid flow. To link vortex shedding to chaos it is necessary to take a *particle centric* rather than a *field centric* approach.

Keywords. Chaos, natural science, complexity, turbulence.

AMS (MOS) subject classification: 37D45.

1 Introduction

In common practice there are three approaches to fluid dynamics: homogeneous fluid dynamics, heterogeneous fluid dynamics and computational fluid dynamics (CFD), [1]. There is no mathematical theory unifying these three areas of fluid dynamics. While the arguments of Batchelor [2] provide a rationalization (not a proof) for the continuum hypothesis for homogeneous fluid dynamics, his arguments do not apply to heterogeneous fluid dynamics.

This paper only discusses heterogeneous fluid flow.

Definition 1 *A purely homogeneous fluid (HFp) is a fluid comprised of a single type of atom.*

Examples are oxygen, Nitrogen and Radon gas.

Definition 2 *An Homogeneous fluid (HF) is a fluid consisting of a mixture of two or more HFps*