

Texas Tech University. Department of Mathematics and Statistics. Colloquium.

# Ensemble Dynamics and Bred Vectors

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Room: CHEM 113. Time: 3:30pm.

**ABSTRACT.** The concept of a “bred vector” dates back to 1993, and Google now has over 500,000 hits in its data base. Two of these hits are found under the title of this lecture. On the other hand this concept has not (as of a week ago) made it into the AMS MathSciNet. One of the most interesting features about this concept is that it plays a central and important role in the related areas of dynamical systems and numerical studies. Nevertheless, the bred vector is a mathematical orphan.

For example, the matter of the sensitivity of model outputs to changes in the initial conditions for weather forecasting is a topic of widespread interest. While bred vectors have been accepted as useful tools in the study of sensitivity, there is a lacking of a sound theoretical basis for the applications of this concept. In this lecture we present some new developments in the theory of bred vectors.

By using a new concept of “ensemble dynamics” we obtain better insights into the part to be played by bred vectors in the theory of dynamical systems. Among other things, we will show how to use ensemble dynamics to obtain a new point of view of the fractal nature of the Lorenz attractor.

Topics that arise in this lecture include: invariant splittings, such as exponential dichotomies, and the multiplicative ergodic theorem. We will also use the Lorenz attractor to motivate one of the basic problems arising in discrete dynamics: Can one find a proof of the apparent robustness of the Lorenz attractor?