

# Dissertation Proposal for J. McCracken

---

## Proposed Title

*Geomagnetic Storm Forecasting with Directionally Correlated Model Parameters*

## Topic Overview

Geomagnetic storms can have measurable, sometimes serious, impacts on many different human systems, including power transmission grids and satellite communications. As such, geomagnetic storm forecasting has become an important topic in the study of space weather. Current forecasting techniques in space weather are varied in both method, scope, and accuracy. Some forecasts aim to predict storms days ahead of time while others work with prediction windows of minutes. Some forecasts rely on purely computational techniques like neural nets and others use combine computational techniques with theoretical models of magnetohydrodynamics. This thesis will focus on forecasting geomagnetic storms using only time series analysis on various solar data sets. A forecasting model will be produced for the storm-disturbance index  $D_{st}$  that includes exogenous parameters found during a “directed correlation” study of the data sets. The concept of “directed correlation” will be introduced and explored as a way to understand driving influences between concurrent time series. Applying the concept of directed correlation to the solar data sets may lead to new insights (or confirm old assumptions) about the space weather system. Such a result is scientifically interesting in its own right, but the hope is that the directed correlation study will identify exogenous parameters that can be used to achieve a more reliable and computationally efficient  $D_{st}$  forecasting model than is currently available.

## Proposed Table of Contents

1. Introduction
2. Directional Correlation
  - (a) Convergent Cross Mapping
  - (b) Transfer Entropy
  - (c) Directional Correlation Definition
3. Directionally Correlated Solar Weather Parameters
  - (a) Understanding Solar Data Sets
  - (b) Directional Correlation Among Solar Data Sets
  - (c) Directional Correlations with  $D_{st}$
4.  $D_{st}$  Forecasting Model
  - (a) Forecasting Models Overview
  - (b)  $D_{st}$  Model with Directionally Correlated Exogenous Parameters
  - (c) Model Evaluation and Comparison

## 5. Conclusions