**Visualizing Uncertainty with Chromatic Aberration**

By

Md Rashidul Islam  
md313724@dal.ca

Supervised by

Dr. Stephen Brooks

Professor

Faculty of Computer Science, Dalhousie University

Submitted in partial fulfilment of the requirements

for the degree of Master of Computer Science

at

Dalhousie University

Faculty of Computer Science, Dalhousie University

Halifax, Nova Scotia

© Dalhousie University 2020. All rights reserved.

**Table of Contents**

**List of Tables**

**List of Figures**

**Abstract:**  
In recent years an increasing array of research are being conducted by researchers in the field of uncertainty visualization that attempt to determine the impact of representations on users’ perception and evaluate its effectiveness in decision making. Uncertainties are often an integral part of data and by nature model predictions also contain significant amounts of uncertain information. A prominent example of uncertainty, COVID-19 is a respiratory infectious disease caused by novel coronavirus. Due to its unprecedented challenges over time and frequent changes of strains, scientists and researchers are investigating the available data to discover the patterns in different demographic areas and examine the effect of vaccinations against different variants. In this study, we explore a novel idea for a visualization to present predictive model uncertainties using Chromatic Aberration (CA). We first utilized existing machine learning models to obtain predictive results using Covid-19 pandemic data and calculated the corresponding model uncertainties for the most impacted countries with respect to number of new-cases, new-deaths, and new-vaccination for different countries. We then visualized the data itself and its associated uncertainties with an artificially spatially separated channels of red, green, and blue color components. This chromatic aberration representation has been evaluated in a comparative user study. <then we leave space for a couple sentences that will briefly describe the results of the user study when known>

**LIST OF ABBREVIATIONS USED**

AI - Artificial Intelligence

API - Application Programming Interface

D3 - Data Driven Documents

HCI - Human Computer Interaction

JSON - JavaScript Object Notation

ANN - Artificial Neural Network

CNN - Convolutional Neural Network

RNN - Recurrent neural networks

MLP - Multilayer Perceptron

LSTM - Long Short-Term Memory

MAE - Mean Absolute Error

RMSE - Root Mean Square Error

WHO - World Health Organization

REB - Research Ethics Board

**Acknowledgements**

I would like to express my heartiest gratitude to my supervisor Dr. Stephen Brooks due to his cordial supervision from the very beginning of the journey. His unparallel thoughts and unlimited patience of listening with highly sophisticated approaches of sharing ideas and clarifying problems or providing suitable directions greatly helped me to reach stage of my thesis component. I revere from my heart for his endless support and guidance and wish for his long and healthy life.

Secondly, I would like to thank my most beloved parents, for their eternal, natural and demand free love and care throughout my life. In addition to that, I can’t forget to contribution of my siblings, friends, and all teachers from my very childhood.

Finally, I would like to appreciate to the user-study participants who helped me to conduct the survey by dedicating their invaluable time and effort.