Projects in Data Visualization

Robert S. Laramee
Robert S. Laramee's interests are focused on the use of computers and their graphic capabilities to generate images, either automatically or interactively, from data, in order to gain insight into that data. Data visualization is a very application-oriented field of computer science with many transferable skills. Thus, any project undertaken with Bob will allow you to finally apply those theoretical skills learned in lectures, improve your programming ability, and supply you with other necessary skills that are applicable both in the real world and in research. Visualization is also very rewarding because you can actually see the results of your work and easily show them to others. The following projects are only a sample of suggested topics. If you would like to discuss other possibilities, please contact Bob directly. Note that an effort will be made to tailor the projects in order to suit the student's interests. We recommend that you enrol in the data visualization module if you choose a visualization project. Videos, lectures, and more information related to these projects can be found on a dedicated YouTube channel on data visualization:
https://www.youtube.com/user/rslaramee/featured
Interested students are encouraged to have a look. All of the previous year's data visualization lectures are also on there.

Project Title: Visualizing the Lipid Journey Through the Membrane Protein Landscape (Computational Biology Visualization)
Description:
The Structural Bioinformatics & Computational Biochemistry group at the University of Oxford runs large and complex simulations of lipid-membrane-protein interactions. The interactions between lipids and membrane proteins play an important role in understanding the dynamic behavior of and structural properties of biological membranes. Biologists at Oxford use Molecular Dynamics (MD) simulations to study the properties of lipid-membrane interaction. However, the simulation data is large and complex. That is why they have asked us to help them visualize their data in order to increase their understanding. This project develops innovative visualizations of MD simulation data.
Collaborator: Dr Mattieu Chavent, Institute of Pharmacology and Structural Biology, matthieu.chavent "at" ipbs.fr, http://www.ipbs.fr/

Project Title: Visualization of Version Variation
Description:
William Shakespeare is one of the world's greatest writers. His plays have been translated into every major living language. In some languages, his plays have been re-translated many times. These translations and re-translations have evolved for about 250 years. Studying variations in translations of world cultural heritage texts is of cross-cultural interest for arts and humanities researchers. The variations between re-translations are due to numerous factors including the differing purposes of translations, genetic relations, cultural and intercultural influences, rivalry between translators, and their varying competence. A team of Digital Humanities researchers has collected an experimental corpus of fifty-five different German re-translations of **Shakespeare's** play, Othello. The re-translations date from between 1766 and 2010. A sub-corpus of 32 re-translations has been prepared as a digital parallel corpus. We would like to develop methods of exploring patterns in variation between different translations. This project, develops an interactive focus+context visualization system to present, analyze and explore variation at the level of user-defined segments. From these visual designs, we are able to obtain an overview of the relationships of similarity between parallel segments in different versions.
Collaborator: Dr Tom Cheesman, Modern Languages, T.Cheesman "at" swansea.ac.uk

Project Title: Visualising Complex Relationships Within Health Care Cost-Effectiveness Models
Description:

Health Economics and Outcomes Research (HEOR) Ltd based in Cardiff develops mathematical models designed to predict the natural history of disease progression. Much of our work is in oncology, diabetes, cardiovascular disease and kidney disease. These models are used to predict the expected impact that newly licensed drugs might have on the progression of a disease compared to current clinical practice. The models developed place a value on the drug from a cost and quality of life perspective by simulating patients based on a range of evidence including data from clinical trials, clinical databases and the published literature. Although these models are published in peer-reviewed journals there is often residual concern about their "black-box" calculation. This is because many of the models are complex and utilise equations not well understood by users of the models. Consequently, communicating how the functional relationships map model inputs to outputs within a time-dynamic models is challenging. This project aims to work with previously developed simulation models to explore ways of visualising these relationships and to experiment with different techniques to be able to convey these relationships easily and effectively.
Collaborators: Prof Phil McEwan, Michael Hurst of HEOR Ltd Health Economics & Outcomes Research Ltd, phil.mcewan "at" heor.co.uk, michael.hurst "at" heor.co.uk

Project Title: Visualising Population Healthcare Data
Description:
This project develops novel, customized, state-of-the-art, interactive visualization techniques for the SAIL project. We will develop visualization techniques guided by the visualization mantra, "Overview first, zoom and filter, then details-on-demand.." (Schneiderman, 1996) We will design visualizations that will enable the user by providing critical overviews of the SAIL data as starting points for exploration. We will also provide zooming and filtering techniques that enable users to interactively select the sub-sets of the data they currently find most interesting. This visualization project also develops novel, state-of-the-art visualization techniques for portraying patient-centred details on demand. We will draw on a wide knowledge-base of visualization expertise and current research literature to provide the most effective visualization solutions for the users.
Collaborators:
Jon David, Pharmacist, jon.david "at" btconnect.com
Julian Halcox, School of Medicine, j.p.j.halcox "at" swansea.ac.uk

Project Title: Visualization of Call Centre Data
Description:
QPC Ltd is a company based in Birmingham that develops software for call centers. The software records every event associated with a call center call, e.g., the time of the call, who called, which menu options they chose, which agents they spoke too, how long the call lasted, if the problem was resolved, etc. While QPC does a very good job at collecting and archiving the data, they struggle with deriving useful information and knowledge from it. They would like help in visualizing the data to increase their understanding of it.
Collaborator: Gary Smith, Director of Research, gary.smith "at" qpc.com

Project Title: Smart City Visualization
Description:
Administrative data is held in abundance by social services, but we often fail to invest time and knowledge to harvest the meaning it holds. The Health, Social Care and Well-Being Act 2014 of the Welsh Government provides an opportunity to rethink the way social services approaches the measurement of performance. The Act also encourages social services to develop stronger local knowledge about the communities being served. Information workers in social services will need to reveal more meaning in our data to help translate that knowledge into management action. This project develops visualization and visual analytic tools to support Swansea City Council by deriving new knowledge of the vast amounts of data they collect.
Collaborator: John Grenfell, Performance and Information Manager at City and County of Swansea, john.grenfell "at" swansea.gov.uk

Project Title: Special Topics in Flow Visualization: Visualizing Flow Past a Marine Turbine

Description:

Computational Fluid Dynamics (CFD) is the discipline of predicting the behavior of flow as it moves through some space, in a quantitative fashion. For example, CFD is used to study the behavior of a liquid as it travels down a winding pipe. The goal of this project is to visualize given CFD simulation data that describes the behavior of flow past a marine turbine. This project involves a collaboration with the Marine Turbine Group in the College of Engineering. Other special topics in flow visualization are possible. For example, visualization of the Bloodhound Supersonic Vehicle (the world's fastest land vehicle) is also a possibility (with Ben Evans).

Collaborator: Ian Masters, Engineering, I.Masters "at" swansea.ac.uk

Title: Visual Exploration of Systems Engineering Integration

Description:

Integrating a Naval Warship is a complex design undertaking, which involves trading many competing design performances at a whole system level. Like most big engineering product development projects, the detailed design phase is dominated by a 3D CAD model, which rapidly becomes the focal point of the integration effort. The business has made significant investment in visualisation software and hardware to achieve this, including a set of networked immersive 3D visualisation suites. However, just as important as exploring and proving this physical integration are the, often less tangible, design problems relating to functional interrelationships of the sub-systems. This project aims to find novel (or transfer established) visualisation to apply to the (often large and challenging) data-sets that the engineering teams rely on to solve their functional systems integration challenges. This data includes information such as requirements, technical risks, interfaces, technical parameters with uncertainty band, design schematics and design justification documentation (such as performance predictions / calculations). It's expected that the Model-based Systems Engineering (MBSE) framework in use in the business will form an important 'back-bone' for usefully mapping and exploring this data in the context of the overall progress and quality in the integration of the ship systems.

Collaborator: Neil Harrison, neil.a.harrison "at" baesystems.com