Navigating complex learning systems

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Complex Systems Research is a multi-disciplinary field, which seeks to understand the flow of information in both hierarchical and non-hierarchical systems to work out how they function, where the weaknesses are and how to develop and adapt them to improve information flow. It has applications for exploring multi-jurisdictional coordination challenges for dealing with large-scale disasters related to food, animals or humans, as well bio-security related threats such as the spread of infections, and crises related to flood, tsunami or fire, as well as humanitarian related disasters.

In solving these problems, it is not adequate to rely on the government hierarchical systems alone. How the government agencies, such as police, fire-fighters or medics, come together to respond to large-scale crises is just part of the picture. There is always a time delay – by the time the government has detected the signals and provided responses, a lot of catastrophic damage has already occurred. With today's social media, the community is often one step ahead. There is a lot of public information available and people use different types of media – Twitter, Facebook, chat engines etc – to propagate and share information.

How people take different signals from the environment, how they adapt to those situations and how they improve their response strategy.

To learn from these, there is a need to develop a platform for extracting information from community-based, public networks and to develop computational capability to put both sides of the information – the government response and the community response – together. In collaboration with

authorities in Australia, for example, our research is focused on investigating large-scale bushfires – how the fire fighters become engaged with the local community and provide safety and recovery efforts, and how different systems and groups of people interconnect with and are interdependent on each other.

We have developed a very large computational learning laboratory grounded on network science, termed a learning hub, to extract patterns of behaviour, represented by a network structure, and look at the evolution of how these groups of actors start working together, and how they emerge as a collective team. We can then make use of this information to improve crisis-response. This is not classroom learning. It is solving complex problems that the world and society are facing. Uncovering how these complex systems work gives rise to many computational challenges including how to understand the emergence of collective behaviour in real time and how to then begin to understand what are the most effective patterns of behaviour for dealing with different kinds of crises. The picture is necessarily wide-ranging in scope. The methodology studies evolution within the time period of the crisis. How people take different signals from the environment, how they adapt to those situations and how they improve their response strategy.

My work in this area includes theoretical and methodological explorations of the effects of social networks and technology in supporting communication flow during crisis, coordinated interventions and delivery of health care and sociology of health, coordination of communication flow during crisis, coordinated interventions and delivery of health care and sociology of health, coordination of public health interventions, social networks in allied health service learning, effects of social networks in the delivery of nutritional health outcome.

Subsequent to my recent work on "Connecting the Dots of Global Ebola Spread", I am leading a project in the region to study the coordination challenges in dealing with biosecurity threats involving both the robust functioning of hierarchical command control structure and the evolving community structure through social media. The goal is to develop an early alert system for the spread of infections, including through the collection and analysis of big open data, and to study the vulnerability of hierarchical systems for dealing with new emerging outbreaks using simulations. This work includes developing a keyword dictionary that will embed HK and Chinese contextual situations, and new approaches for search query and correlation analysis.