

On Leveraging Social Informatics for Transportation Cyber Physical Systems

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Our project will investigate the relationship between social informatics and transportation cyber physical systems. *Social informatics* studies the social-behavioral perspective of individuals or communities via information and communication tools, potentially under different cultural contexts. It also concerns the design, uses and consequences of information technologies, such as cyber physical systems, that take into account their real-time interactions with both other nearby human users and the Internet as a society.

CPS technologies have been developed to improve safety in navigation, and to offer a convenient and comfortable environment for both drivers and passengers in vehicles or public/metro transportation systems. On the other hand, principles from social psychology have been applied to historical/survey data from traffic accidents in order to understand the correlation between undesirable driving behaviors and social influence models. Given the recent development of social interaction platforms and applications, our objective here is to integrate these two bodies of work together for future social-aware transportation systems.

Behavioral study via CPS technologies and social informatics: Existing social psychology studies of transportation were somewhat limited due to the sources of input data and monitoring technologies available. For instance, existing highway accident data provides essentially little/no information regarding “under what situations/reasons, certain accidents have been avoided (but could have occurred, otherwise)”. These unavailable pieces of information could be embedded in details such as social activities inside or outside of the transportation systems themselves. These might include personality/characteristics of the drivers/passengers, related life events such as stress or significant status updates, personal health condition and medicine side-effects, as broad as community development, social/political mobilization, or financial market activities. CPS technologies, together with social informatics, have the potentials to not only monitor and detect the behavioral/emotional changes of the targets, but also to connect these changes to the extra information around our life.

CPS with Social Real-Time Awareness: Social media systems such as Twitter and Facebook provide our modern society a platform for information sharing and propagation via our relationship network. With the new development of social data analytics, valuable information regarding the drivers/passengers (or even near-by drivers) can be derived in real-time and leveraged by the cyber physical systems. For instance, the social informatics plane, together with CPS, might identify a significant level of risk for a particular driver to behave undesirably during next couple hours, given factors such as personal struggles and traffic congestion. The CPS might then advise/suggest options for the driver or other nearby passengers to control and operate the transportation environment differently, in order to proactively reduce the vulnerability.

Security and Privacy of Social-aware CPS: The approach we proposed earlier will introduce new challenges for security and privacy protection. On one hand, the range and depth of personal data the CPS touches might seriously expose our private life in every single detail. On the other

hand, it could well be, only via those precious personal information (and the social awareness being derived from them), that the safety of our overall transportations can be greatly improved. Therefore, it is an important research goal for us to understand the trade-off and balance between the usefulness and security/privacy of any social-aware cyber physical system.

About the Team and the PI

Our research team consists of faculty and research scientists from different academic units such as Communication, Civil Engineering, Computer Science, Sociology, Economics, and Energy Efficiency Center at UC Davis.

Prof. S. Felix Wu has been doing “experimental” system research, i.e., building prototype systems to justify and validate novel architectural concepts. Since 1995, he and his students/postdocs have built many experimental systems in the areas of fault tolerant network, IPSec/VPN security policy, attack source tracing, wireless network security, intrusion detection and response, visual information analytics, and, more recently, future Internet design. An article titled "Networking: Four ways to reinvent the Internet" published in Nature 463 (February 3rd, 2010, by Katharine Gammon) provided a brief but very nice cover about his primary thought on a Social-network-based future Internet architecture (much more comprehensible than if he were to write it, actually). During the past eight years, he has been pretending (and hoping) to know a little bit more about humanity science so he can claim that he is working on multidisciplinary research. And, he strongly believes that thoroughly considering the factor of human relationships is necessary for any IT innovation. Therefore, his primary research objective, before he retires, is to help and contribute to the information technology advancement that would truly help our human society such as security, safety, and sustainability. As an initial step, he recently released the SINCERE (Social Interactive Networking and Conversation Entropy Ranking Engine, sponsored by NSF) search engine under <http://www.sincere.se>, which is trying to help our Internet society to discover "interesting/unusual/valuable" social informatics. Felix received his BS from Tunghai University, Taiwan, in 1985, both MS and PhD from Columbia University in 1989 and 1995, all in Computer Science. He has about 110+ academic publications, which means that he should probably focus much more on the depth and quality. He is currently a Professor with the Computer Science department at UC Davis.