

Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Detecting critical state before phase transition of complex systems by hidden Markov model RUI LIU, PEI CHEN, YONGJUN LI, South China University of Technology, LUONAN CHEN, Shanghai Institutes for Biological Sciences — Identifying the critical state or pre-transition state just before the occurrence of a phase transition is a challenging task, because the state of the system may show little apparent change before this critical transition during the gradual parameter variations. Such dynamics of phase transition is generally composed of three stages, i.e., before-transition state, pre-transition state, and after-transition state, which can be considered as three different Markov processes. Thus, based on this dynamical feature, we present a novel computational method, i.e., hidden Markov model (HMM), to detect the switching point of the two Markov processes from the before-transition state (a stationary Markov process) to the pre-transition state (a time-varying Markov process), thereby identifying the pre-transition state or early-warning signals of the phase transition. To validate the effectiveness, we apply this method to detect the signals of the imminent phase transitions of complex systems based on the simulated datasets, and further identify the pre-transition states as well as their critical modules for three real datasets, i.e., the acute lung injury triggered by phosgene inhalation, MCF-7 human breast cancer caused by heregulin, and HCV-induced dysplasia and hepatocellular carcinoma.

Rui Liu
South China University of Technology

Date submitted: 05 Nov 2015

Electronic form version 1.4