

MAR13-2012-020308

Abstract for an Invited Paper  
for the MAR13 Meeting of  
the American Physical Society

**Controllability and observability of biological systems**

YANG-YU LIU, Northeastern University and Dana-Farber Cancer Institute

The ultimate proof of our understanding of complex biological systems is reflected in our ability to control them. Although control theory offers mathematical tools for steering engineered systems towards a desired state, a framework to control complex biological systems is lacking. In this talk I will show that many dynamic properties of complex biological systems can be quantitatively studied, via a combination of tools from control theory, network science and statistical physics. In particular, I will focus on two dual concepts, i.e. controllability and observability, of general complex biological systems. Controllability concerns our ability to drive the system from any initial state to any final state within finite time, while observability concerns the possibility to deduce the system's internal state from observing its input-output behavior. I will show that by exploring the underlying network structure of complex biological systems one can determine the driver (or sensor) nodes that with time-dependent inputs (or measurements) will enable us to fully control (or observe) the whole system.