Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

Case ID:M20-124L
Published: 11/30/2020

Inventors

Enrico Borriello
Kimberly Bussey
Sara Walker

Contact

Jovan Heusser
jovan.heusser@skysonginnovations.com

System and Methods to Steer Network Dynamics

Steering complex networks, with many interconnected nodes, towards a desired evolution or target "attractor" state is difficult. However, it is of great practical interest in many areas of science, particularly genetics. Current methods that attempt to steer complex networks to a desired attractor state need continual intervention with the dynamics of the system. Not only does this require significant overhead and human operators, but in the event intervention is terminated, the network is not able to regulate its own dynamics to arrive at the target attractor state.

Researchers at Arizona State University have developed a novel system and methods to steer network dynamics, making neural network attractors more efficient. This system identifies existing components of the network and modifies them in a specified order to converge on the desired attractor without external intervention. The system and methods are both permanent and open-ended with respect to the number of possible attractors available to the network. This allows the user to specify any constraints on nodes such as the practical ability to duplicate and/or change the node or a desired multimode configuration in the resulting attractor. Any system that can be described as a network with solvable dynamics can make use of this system.

This novel system for steering network dynamics can be applied to many areas in science, but has particular application in gene regulatory networks and other biological processes.

Potential Applications

- Steering collective network behavior
- Modification of biological networks in place of drug delivery
- Control methods for gene therapy
- GMOs and Crop sustainability without introduction of exogenous genes
- Engineering metabolic pathways
- Synthetic biology – able to build novel functionality

- Cancer regulation – determine which therapeutics could force cancer to mutate to a benign state
- Bioproduction scale-up
- Cell differentiation
- Basic research
- Increasing reliability of a manufacturing process or engineered network

Benefits and Advantages

- The method is permanent and open ended regarding the number of possible attractors available to the network.
- The algorithm allows a user to specify desired constraints on nodes and can be used on any network with solvable dynamics
- The algorithm doesn't require something from outside the network to produce an effect
- Relaxes the one-to-one identification between cell types and attractors
- Opens up the possibility to perform in silico studies of the mutation events compatible with observed phenotypic divergence of closely related species

For more information about this opportunity, please see

Boriello et al - J Exp Zool B Mol Dev Evol - 2020

For more information about the inventor(s) and their research, please see

Dr. Walker's departmental webpage

Dr. Bussey's departmental webpage

Dr. Borriello's departmental webpage