# Quantifying the notion of a canalizing gene in a gene regulatory network

Eunji Kim[1], Ivan Ivanov[2], Edward R. Dougherty[1]

[1] Department of Electrical and Computer Engineering, Texas A&M University, College Station, TX, 77843, USA

eunjikim@tamu.edu

[2] Department of Veterinary Physiology and Pharmacology, Texas A&M University, College Station, TX, 77843, USA.

IIvanov@cvm.tamu.edu

Genomic regulatory networks are examples of complex systems with distributed control and abundant feedback. The concept of genes that can constrain, or canalize, such a complex network to a specific behavior was first proposed by C. Waddington in 1942 [1]. Waddington stipulated the existence of genes that can produce reliable developmental effects against genetic mutations or environmental changes during evolution [2], [1]. Zhao et al. [3] made a clear distinction between master genes and canalizing genes. Both master and canalizing genes exert a strong control over many downstream gene pathways; however, canalizing genes have an additional ability of taking over the control and overriding other regulatory instructions. Canalizing genes produce adaptive and optimal reactions to environmental, stochastic and genetic perturbations and they are essential in a complex system, so it can achieve biological robustness and buffer itself from the effects of random alterations or operating errors. Our work also suggests that the currently adopted definitions of canalizing and master genes should be modified to include a relative characterization of these properties in such a way that a particular gene does not have to be exclusively a master or a canalizing one.

# References

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