AzTE Arizona Technology Enterprises

www.azte.com

Inventors

William Ditto

Director and Professor

School of Biological and Health Systems Engineering

Raj Mohanty

Associate Professor

Physics Department

 Boston University

Sudeshna Sinha

Professor

Institute of Mathematical Sciences

University of Madras

Adi Bulsara

Senior Scientist

2SPAWAR Systems Center Pacific

Intellectual Property Status

Patent pending

Contact

Bill Loux

Director of Business Development

Arizona Technology Enterprises, LLC (AzTE)

480.884.1996 main

480.884.1992 desk

Email: bloux@azte.com

A Noise-Assisted Reprogrammable Nanomechanical Logic Gate

AzTE Case # *M10-112*

Background

Logic operations with two states, logic elements or gates, dominate modern computation. Despite recent experimental efforts, mechanical logic at very small length scales with a noise floor present has been difficult to realize. However, the control and manipulation of mechanical response at the nanometer level can be realized through exploitation of stochastic resonance. If this process is applied in a nonlinear mechanical system, the addition of noise can amplify the response to an external stimulus. There has been recent confirmation that when two square waves are applied as input stimuli to a two-state system, the response can be a specific logical output with the likelihood of obtaining this output determined by the noise intensity. Additionally, the system output can "morph" into a different logic operation if the threshold is changed either by adjusting the nonlinearity strength or applying a controlled asymmetrizing DC signal.

Invention Description

Researchers at Arizona State University and other institutions have collaborated to create a nanomechanical device that operates as a reprogrammable logic gate in performing fundamental logic functions such as AND/OR and NAND/NOR. The logic function can be programmed dynamically by altering the operating parameters of the resonator. The device can access one of two stable steady states according to a specific logic function. This action is moderated by the noise floor, which can be directly adjusted or dynamically "tuned" with an adjustment to the nonlinearity of the resonator. Hence, having direct control over the noise floor is not required. Achieving this capability with power consumption and size similar to the current CMOS logic gates is a step toward the practical realization of an alternative architecture that surpasses the limit at which current microprocessors can be scaled.

Potential Applications

- Morphing logic gates and reconfigurable computer architectures
  - Electronic or Biological systems

Benefits and Advantages

- Allows dynamic tuning of existing or injected noise to nonlinear systems
- Eliminates need to have direct control over noise floor
- Very small mechanical logic elements