



Seminar

3:00 p.m. Wednesday, October 31st, 2012
235 Weir Hall

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Codeword Design for Biomolecular Programming

Abstract

The holy grail of biomolecular computing (BMC) is the design of self-assemblable nanodevices endowed with enough prowess to interact intelligently within living cells. While biomolecules have resolved fundamental problems as a parallel computer system that we are just beginning to decipher, BMC still suffers from our inability to harness these properties to bring biomolecular interactions to levels of reliability, efficiency and scalability that are now taken for granted with solid-state based computers. Finding large sets of single DNA strands that do not crosshybridize to themselves or to their complements has become an important problem in DNA computing, self-assembly, DNA memories and phylogenetic analyses, because of their error correction and prevention properties. We provide a quick survey of advances in this area in the last few years and focus on a novel combinatorial/geometric framework to analyze this problem. In this framework, codeword design is reduced to finding large sets of strands maximally separated in DNA spaces and therefore the size of such sets depends on the geometry of these DNA spaces. Finally, we present a new general technique to embed DNA spaces in Euclidean spaces and thus, among others, reduce the word design problem to the well-known sphere packing problem in higher dimensional Euclidean spheres. Finally, we sketch two applications to genome-wide phylogenetic analyses in Bioinformatics and Natural Language Processing *in vitro*.

Bio:

Max Garzon joined the University of Memphis in 1984 after finishing his Ph.D. at the University of Illinois, Urbana. In his early career, he did research on the complexity of symmetric computational memory structures for sequential computers and separation of sequential complexity classes. His current research focuses on interactive computing, broadly including parallel and distributed computing and human-computer interaction, both in the traditional areas and the emerging areas of biomolecular programming and bioinformatics. In addition to over 150 publications in these areas, including four books and numerous special issues, he has developed or been instrumental in developing software products for complex systems simulation and control, such as *Edna* (a virtual test tube), early versions of *Autotutor* (an intelligent computer-based tutoring system for instruction in computer literacy and conceptual physics), online election system and a variety of software solutions for local business and industries as part of internships and outreach projects. His research has been funded by NSF, AFOSR and other agencies. He is a senior member

of ACM, IEEE and member of the editorial board of the *International J. of and Nanotechnology and Molecular Computing*, and *Genetic Programming and Evolvable Machines*, among others.