FINAL REPORT
PROFESSIONAL DEVELOPMENT ASSIGNMENT
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Abstract

I spent this leave catching up with a backlog of publications, unfinished research projects and academic visits to renew professional contacts at universities in Spain, Czech republic and Colombia. My primary research activities concerned the use of **biomolecular computing**, **bioinformatics** and **synthetic biology** to tackle several research problems. First, the fundamental problem of developing better methods for biomolecular computing and synthetic biology. Second, the use of such methods to develop a next-generation of microarrays for genomic and transcriptomic analyses. Potential applications of these ideas include information storage in DNA databases and knowledge repositories, an implementation of nxh chips on standard microarray technology for genomic analyses, and semantic understanding of natural language by artificial systems. Six (7) papers, a class in Data Science, and planning work for a special issue on "Next Generation Genomic Analysis" were produced during this leave. In addition, I furthered talks to establish a dual degree program with the National University of Colombia to expand M.S. and Ph.D. programs at the U of Memphis.

Scholarly Activities

This leave took place the period August 2016 to August, 2017, with research at home (Fall semester) and visits to ***The University of Silesia (Czech Republic), University of Granada (Spain),*** and ***The National U of Colombia*** (Spring Semester). I attended conferences to deliver five (5) papers, talks, and tutorials at several venues, as described below.

Five (5) papers at

- 16th UCNC *International Conference on Unconventional Computation and Natural Computation* in Fayetteville, Arkansas, June 5-9, 2017 [5,6]
- IWBBIO'17-International Work-Conference on Bioinformatics and Biomedical Engineering, Granada Spain [2]
- BICoB'17-International Conference on Bioinformatics and Computational Biology, International Society for Computer Applications ISCA, Honolulu, Hawaii [1].
- BIBE'17-IEEE International Conference on Bioinformatics and Bioengineering [3].
- CMC'18-Conference on Membrane Computing, Bradford, UK [4].

Invited talks

"*Algorithmic Self-Assembly and bioNanotechnology: The Interface*"
Computer Science and System Engineering Department, National University of Colombia, in Bogota, Colombia, February 24, 2017.

Summer course on Data Science

Second, (co-)organized, with Luis Fernando Nino (UM Alumnus'2000) at the University of Colombia-Bogota, a course in data science on *Data Science in Bioinformatics,* as part of their

Summer program in the School of Engineering. Details are at
http://bmc.memphis.edu/biods.
Eighteen (18) participants worked on a variety of projects. Two students have continued to work on two research projects based on their term project [11,12]. They are also interested in applying for admission as graduate students at the U of Memphis in the near future.

Special Issue of *Frontiers in Physics*

Third, I also made substantial progress on a special issue of the journal *Frontiers in Physics* [10] and am in the process of finalizing about eight (8) articles for publication in the issue by other authors and myself or my students.

Fourth, I submitted two proposals to NSF (both declined, one with good reviews, in re-submission) and **refereed** over 12 papers and 24 NSF proposals.

Research Activities

In addition, I advanced fundamental research with my Ph.D. students in Memphis (Tyler Moore and Sambriddhi Mainali) and M.S. students (Ravi Bhattarai, Rihana Bailey, Charles Lancaster and Cheneel McNutt). Some of the topics are:

- Fundamental research in biomolecular computing (design of noncrosshybriding bases for next generation microarray designs and DNA self-assembly.)
- New techniques in self-assembly for electronic nanotechnology (introduced a new model for self-assembly of electric circuits.)
- New methods for knowledge-based in software engineering process. Students are designing a new module for evaluation (EEM) of the larger R.E.M. (Resource Elicitation Module) for small to medium software projects.

In summary, the PDA freed my creative energies and time to produce substantial output during the Summer of 2017. I have not been able to produce these while on regular duties at home in the last 8 years.

Publications and Conferences

1. **M. Garzon** and S. Mainali (2017). Towards a Universal Genomic Positioning System: Phylogenetics and Species Identification. Proc. IWBBIO'17-Int. Work- Conference on Bioinformatics and Biomedical Engineering Lecture Notes in Bioinformatics -LNBI 10209, , 469-479.
2. **M. Garzon** and S. Mainali (2017). Towards Reliable Microarray Analysis and Design. Proc. BICoB'17-Int Conference on Bioinformatics and Computational Biology, Int. Society for Computer Applications ISCA. 6 pp.
3. **M. Garzon** and Duy Pham (2017). Genomic Approaches to Hospital Acquired Bacterial Infection Identification. BIBE'17- IEEE Int. Conference on Bioinformatics and Bioengineering (under review).
4. Petr Sosik, V. Smolka, J. Drastik, J. Bradik, **Max H. Garzon.** On the Robust Power of Morphogenetic Systems for Time Bounded Computation. Proc. CMC18-Conference on Membrane Computing 2018, 333-358.
5. Petr Sosik, V. Smolka, J. Drastik, Tyler Moore, **Max H. Garzon.** Morphogenetic and Homeostatic Self-Assembled Systems (2017). UCNC'17-Unconventional Computation and Natural Computation, Fayetteville, AR, LNCS 10240, 144-159.
6. Russell Deaton**.** Rojoba Yasmin, Tyler Moore, **Max H. Garzon**, Self-Assembled DC Resistive Circuits with Self-Controlled Voltage-based Growth (2017). Proc. UCNC'17-Unconventional Computation and Natural Computation, Fayetteville, AR, LNCS 10240, 129-143.
7. **Max H. Garzon**, Tyler Moore, Htang Naing Russell Deaton (2017). Probabilistic Analysis of Self-Assembly. (Submitted.)
8. S. Mainali and **M. Garzon** (2017). A New Methodology for Phylogenetic Analysis and the Tree of Life of the Biome. (In preparation.)
9. **M. Garzon** (2017). On the Structure of DNA Spaces and Gibbs Energy Landscapes. BIBE'17- IEEE Int. Conference on Bioinformatics and Bioengineering. (In Preparation.)
10. **M. Garzon** and Russell Deaton (eds.) (2018). New Approaches to Molecular Phylogenetics, Species Identification and Analytics of the Biome. *Special issue of the journal Frontiers in Physics.* (In Preparation.)