Designing Malleable Experimental HPC Designs

Creating Major Social Change Simulations

Mark C. Davis†
Chief Technical Officer
Wood Duck Research, Inc.
Mooresville, NC, USA
davismc@ieee.org

Jennifer H. Nolan, Dan M. Davis & John J. Tran
President and Computer Science
Catholic Polytechnic University
Pasadena, CA, USA
{ jnolan, ddavis & jtran}@catholicpolytechnic.org

E. Philip Amburn
Computer Science
University of Arizona
Tucson, AZ, USA
phil.amburn@gmail.com

ABSTRACT

Envisioning and designing High Performance Computation (HPC) programs have a unique role in preparing society for major shifts in needs and values. This paper addresses the confluence of two major "tsunamis" of societal change: the emergence of dramatically enhanced capabilities in HPC and the impending displacement of transportation technologies. It asserts that the pre-nascent appearances of both of these emerging paradigms are further bifurcated into two major currents. HPC is facing both hardware advances e.g. Quantum Computing and software approaches e.g. Deep Learning. The transportation future suggests a move toward alternative fuels and toward self-piloted vehicles. Further, the team recognized a need for an enhancement of faith in the scientific method by both the public and by the decision-making strata. The team was assembled to consider the development of an experimental design to best address the following issues: a defensible experimental design, a malleable approach to facilitate incorporation of shifting capabilities, and a compelling data visualization strategy to communicate experimental insights to a range of target audiences. Another desirable feature would be an inherent apologetics mechanism to respond to factions who seek public and political goals, not scientific purity. The team was carefully crafted to be made up of technical personnel with no pronounced emotional investment in the final outcomes of these developments. This paper asserts no proposed final resolution of the issues. These will, nevertheless, will have major impact on the industrial societies.

The HPC community currently faces two major challenges in achieving these goals of developing a robust HPC experimental design. The first is the difficulty of allowing for the seamless incorporation of emerging technologies and techniques. The second is constructing a virtually unassailable Verification, Validation and Test (VV&T) strategy. It must be compelling to both the professional science community and the lay community. The paper first identifies the need for careful definition of the issues to be illuminated, past efforts to achieve these goals, and observed impediments to that achievement. The composition of the team was deemed as critical. Then the composition of the team is discussed, with special attention to the rationales for the inclusion of behavioral and neural scientists, data visualization researchers, industrial computer design developers, and theoretical physicists. This was an ad-hoc team, with no intention of gain or further collective activity.

The paper then turns to a quick review of the impacts of past evolutions in transportation and the painful disruptions occasioned thereby. Next there is a survey of the issues now beginning to be observed as the industrial societies as we move from fossil fuels to renewable or more efficient energy production and utilization. Self-driving autonomy will be described and characterized. A similar analysis examines some of the evolution of HPC, A quick attempt at and overview quantifying the impacts in time scales of both hardware and software is presented. Then a review of some of the impacts of HPC will be presented, with the emphasis on the obstacles to efficient adoption of the power of HPC as was witnessed during some of the authors' five decades of work in computers. More difficult is assessing the future timing of the advent of the new technologies and techniques that may enable the analyses proposed in the proffered experimental design template. A hard look at the error bands of projections indicates the seriousness of the analysis. That template is finally laid out, explicated and justified.

CCS CONCEPTS

• Insert CCS text here • Insert CCS text here • Insert CCS text here

KEYWORDS

Emerging Technologies, Disruptive Technologies, Behavior Modeling, Quantum Computation, Experimental Design.

ACM Reference format:

Mark C. Davis, Jennnifer H. Nolan, Dan M. Davis, and E. Philip Amberun 2023. I Designing Malleable Experimental HPC Designs: Creating Major Social Change Simulations. In *Proceedings of SC23 ACM, New York, NY, USA, 10 pages.* https://doi.org/10.1145/1234567890

1. Introduction

Heilmeier catechism treatment of subject.

1.1. Paper Organization

This paper is laid out in the following ordes:

1.1.1 Background

1.1.1.1 Internal combustion engine

1.1.1.2 20th Century Computer Revolution

1.1.1.3 Electrification of the Industrial World

1.1.1.4 Urbanization

1.1.1.5 Concept of Disruptive Technologies

1.1.1.6 Need for Emerging Technologies

1.1.1.7 Setting Goals

1.1.2 Foreseen issues with alternative power

1.1.3 Foreseen issues with Autonomous Vehicles

1.1.4 Emerging Capabilities in Quantum Computing

1.1.5 Emerging Capabilities in Big Data

1.1.6 Emerging Capabilities in AI/Deep Learning

1.1.7 Pre-nascent Capabilities in Behavior Modeling

1.1.8 Projections needed for Decision Makers

1.1.9 Optimal way to Convey the Ranges of thoseProjections

1.1.10 Discussion of Risk and Mitigation Thereof

*1.1.11 Verification, Validation and Test (VV*T) Issues*

1.1.12 Conclusion

1.2. Background

2. Foreseen issues with alternative power

3. Foreseen issues with Autonomous Vehicles

4. Emerging Capabilities in Quantum Computing

5. Emerging Capabilities in Big Data

6. Emerging Capabilities in AI/Deep Learning

7. Pre-nascent Capabilities in Behavior Modeling

8. Projections needed for Decision Makers

9. Optimal way to Convey the Ranges of those Projections

10. Discussion of Risk and Mitigation Thereof

11. Verification, Validation and Test (VV*T) Issues

12. Conclusion

paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here.

ACKNOWLEDGMENTS

Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here. Insert paragraph text here.

REFERENCES

[1] Patricia S. Abril and Robert Plant, 2007. The patent holder's dilemma: Buy, sell, or troll? *Commun. ACM* 50, 1 (Jan, 2007), 36-44. DOI: https://doi.org/10.1145/1188913.1188915.

[2] Sten Andler. 1979. Predicate path expressions. In *Proceedings of the 6th. ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages (POPL '79)*. ACM Press, New York, NY, 226-236. DOI:https://doi.org/10.1145/567752.567774

[3] Ian Editor (Ed.). 2007. *The title of book one* (1st. ed.). The name of the series one, Vol. 9. University of Chicago Press, Chicago. DOI:https://doi.org/10.1007/3-540-09237-4.

[4] David Kosiur. 2001. *Understanding Policy-Based Networking* (2nd. ed.). Wiley, New York, NY..