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4. TITLE AND SUBTITLE

Final Report: An Instrumentation Request for Upgrading Euler, a CPU-GPU Heterogeneous Cluster Supporting Research and Educational Activities in Multi-Physics Modeling and Simulation

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W911NF-18-1-0476

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER
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6. AUTHORS

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7. PERFORMING ORGANIZATION NAMES AND ADDRESSES

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8. PERFORMING ORGANIZATION REPORT NUMBER

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12. DISTRIBUTION AVAILIBILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

14. ABSTRACT

15. SUBJECT TERMS

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a. REPORT	b. ABSTRACT	c. THIS PAGE			Dan Negrut
UU	UU	UU	UU		19b. TELEPHONE NUMBER: 608-890-0914

RPPR Final Report
as of 21-Jan-2020

Agency Code:

Proposal Number: 72087MARIP **Agreement Number: W911NF-18-1-0476**
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DUNS Number: 161202122 EIN: 396006492
Report Date: 27-Dec-2019 Date Received: 20-Jan-2020
Final Report for Period Beginning 28-Sep-2018 and Ending 27-Sep-2019
Title: An Instrumentation Request for Upgrading Euler, a CPU-GPU Heterogeneous Cluster Supporting Research and Educational Activities in Multi-Physics Modeling and Simulation
Begin Performance Period: 28-Sep-2018 **End Performance Period:** 27-Sep-2019
Report Term: 0-Other
Submitted By: Dan Negrut Email: NEGRUT@ENGR.WISC.EDU
Phone: (608) 890-0914
Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees: **STEM Participants:**

Major Goals: The following computer systems were purchased using the funding provided by DOD award # W911NF1810476

- 1 IBM POWER9 8335-GTH AC922 System with 4x NVIDIA V100 GPUs
- 1 Ace Powerworks GPU Server with 4x NVIDIA V100 GPUs
- 2 SuperMicro A+ 4023S-TRT Servers
- 1 SuperMicro SYS-2029TP-HTR Chassis with Four Compute Nodes
- 4 NVIDIA Jetson AGX Xavier Development Kits

These systems were integrated into the Euler Cluster, a heterogeneous supercomputer used by Negrut and collaborators at the University of Wisconsin – Madison in order to run large scale and high-performance simulations of multibody dynamics, computational fluid dynamics, and computer vision. These systems were selected because they provide modern CPU and GPU hardware accelerators for these types of simulations. They contain components which would otherwise not be available to these researchers, e.g., Tensor Core accelerated GPUs, the NVLink interconnect, IBM POWER, AMD EPYC, Intel Xeon Gold CPUs, and NVIDIA's embedded Arm CPU+GPU systems.

Additionally, several GPU devices and accessories were purchased in order to replace both obsolete and defective hardware already present in the Euler Cluster

- 4 EVGA Black Edition NVIDIA RTX 2080 Ti GPUs
- 4 NVIDIA RTX 2080 Ti Founders Edition GPUs
- 2 NVIDIA Titan RTX GPUs
- 2 NVLink/SLI bridges for GeForce RTX devices
- 1 APC Rack-mountable PDU

These components filled critical gaps in Euler's available hardware offering including the space left by the

retirement of several NVIDIA GTX 680 GPUs which were too old to meet user demand. As a direct result of its modernizing role within the Euler Cluster, researchers were provided the additional memory and performance needed to explore the simulation of granular media on the order of billions of degrees of freedom.

Lastly, the following server and components were purchased to supplement the storage infrastucture of the Euler Cluster.

- 1 SuperMicro SYS-6019U-TN4RT with NVMe Storage
- 36 Seagate enterprise hard drives

These components provide additional capacity and performance to enable the cluster to handle a more diverse simulation workload. It is of note that this specifically served to alleviate the critical levels of latency caused by the constant use of multiple-terabyte training datasets for machine learning research.

Accomplishments: Accomplishments listed under goals.

Training Opportunities: There was no training associated with this project.

Results Dissemination: There is no dissemination associated with this project.

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI
Participant: Dan Negrut
Person Months Worked: 1.00 **Funding Support:**
Project Contribution:
International Collaboration:
International Travel:
National Academy Member: N
Other Collaborators:

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