A. Project Title

Investigating the Impact of Genome Content on Hybridized Chestnut Trees for Growth Form Utilizing Remote Sensing Techniques: Lesesne State Forest (Nelson Co., VA)

B. Summary

In hybridized chestnut trees, the structure of a tree will look either like a Chinese chestnut tree or an American chestnut tree. While the genome ratio of a single chestnut tree will determine the form, the threshold at which the form is determined is unknown. Previously, multiple point-cloud generating technologies (drone-based laser scanning [DLS], structure-from-motion imagery from a drone [SfM], and terrestrial laser scanning [TLS]) were utilized at The American Chestnut Foundation's (TACF) Duncan and Price Farms to evaluate the efficacy of utilizing remote sensing techniques to quantify chestnut tree structural characteristics. This research has been quite successful and continues as we attempt to better understand the point cloud capturing capabilities of these technologies during the leaf-off season. The main objective of this proposed research is to utilize high-resolution light detecting and ranging (i.e., lidar) scanning methods (both DLS and TLS) combined with machine learning to produce a quantitative genome range at which the tree can be said to have a definite form. The focus of this research will be the Lesesne State Forest (Nelson County, VA) where there are thousands of American, Chinese, American-Chinese backcross, and American-Chinese-Japanese hybrids that were planted as part of Virginia Department of Forestry's (VDOF) chestnut breeding program from decades past.

C. Principle Investigator(s)

W. Cully Hession, Professor
Department of Biological Systems Engineering
Virginia Tech
Email: chession@vt.edu

Yohtaro Kobayashi, Graduate Research Assistant
Department of Biological Systems Engineering
Virginia Tech
Email: yckobayashi@vt.edu

Jonathan Resop, Lecturer
Department of Geographical Sciences
University of Maryland
Email: resop@umd.edu

D. Duration of the Project

December 2022 – November 2023 (or 12 month from receiving funding)

E. Total Amount Requested

$9,794.50

F. Short- and Long-Term Goals

Short-Term Goals

- Lidar
  - Collect aerial point cloud data using drone laser scanning (DLS)
  - Collect ground point cloud data using terrestrial laser scanning (TLS)
- Imagery
  - Collect aerial imagery using drone-based structure-from-motion (SfM)
- Lidar Analyses
  - Merge DLS with TLS point clouds
  - Extract tree structure characteristics from the point cloud data
- Imagery Analyses
  - Create an orthomosaic of the aerial images to deliver an up-to-date aerial map of the area-of-interest to TACF and VDOF
- Compare structural characteristics
  - Lidar-derived metrics vs field measurements
- Machine Learning
  - Process the products of the point clouds in a machine learning algorithm (simple regression, random forest, etc.)
  - For example, some preliminary analysis from the TACF Duncan Farm: https://www.terpconnect.umd.edu/~resop/chestnut/Duncan_Trees_Python.html

Long-Term Goals

- From the machine learning results, determine a quantitative range of genome content at which the form of a hybridized chestnut tree tends more towards Chinese or American.
- Integrate and modify the workflow developed from previous research that utilized lidar technology to phenotype a chestnut tree. The modified workflow will be provided to both TACF and the VDOF.
- Develop and submit a larger research proposal (with TACF as collaborators) to appropriate funding opportunities (e.g., USDA-NIFA).

G. Narrative

1. Introduction

The American chestnut tree (*Castanea dentata*) was once prolific in the eastern United States, numbering in the billions. The wood from the trees was used for various purposes, such as furniture, telephone poles, and structures, to name a few. The chestnuts were a source of food for wild turkeys, squirrels, and many other wildlife [1]. In the first decade of the 20th century, *Cryphonectria parasitica,* the fungus that causes the lethal chestnut blight disease, was introduced into the United States on a horticultural specimen of an Asiatic chestnut species (likely *C. crenata*). The fungus infects the stem tissue of the chestnut tree and creates a canker that effectively girdles and kills the tree. While the Asian *Castanea* species are largely resistant to the fungus, unfortunately, the American chestnut tree is not [2]. The blight caused by the fungus has wiped out most of the American chestnut trees in the US. While the tree is not completely extinct, as the underlying root system still exists, the forests of massive chestnut trees are long gone.

There has been ongoing research towards hybridizing the American chestnut tree with the Chinese chestnut tree (*C. mollissima*) since the 1920s [3]. The end goal of the research is to develop a chestnut tree with the structure of an American chestnut and the blight resistance of a Chinese chestnut. While the American chestnut grows tall and straight, the Chinese chestnut tree is shorter with branches splitting off closer to the ground. However, the process of phenotyping the inventory of chestnut trees at the scale of large orchards requires both extensive manpower and time.

Lidar (i.e., light detection and ranging) is an active sensor that sends out a beam of light, which then bounces off an object and returns to the sensor. Using the speed of light and the time it took for the beam of light to return to the sensor, the distance between the sensor and the object can be derived. The beam is capable of penetrating through certain materials to collect points behind the object that the beam first encountered [4]. The result is a point cloud representing a collection of all the points in space the beam bounced off of. The point cloud can be processed into various algorithms to pull out tree metrics such as height and canopy diameter [5]. Furthermore, the point clouds can be used to reconstruct tree models to obtain branch structures [6]. While traditionally lidar is mounted to manned aircraft, for additional flexibility lidar can be equipped to alternative platforms, such as tripods on the ground (TLS) or drones (DLS), to produce higher-resolution point clouds [7].

There are tradeoffs between using drone-based laser scanning (DLS) and terrestrial laser scanning (TLS) for measuring tree structure. While DLS can produce a high-resolution point cloud, TLS has the advantage of obtaining higher-resolution point clouds at the cost of mobility. There is also the advantage of less cost as a drone is not required. A paper by [8] found that the density of the point cloud correlates with the accuracy of metrics from lidar and field measurements. The stems of a tree are measured less accurately with DLS, and the canopy measurements are less accurate with TLS [9]. Depending on the research purpose, using just one or both (DLS and TLS) should be considered.

Analyzing a multivariate dataset can be a struggle as the size of the dataset starts to increase. Machine learning techniques can be utilized to overcome the difficulties. In a paper by [10], they proposed applying machine learning to forests to better understand the underlying relationships of the phenotype and other factors. In addition, Mosin et al. classified trees in a forest with machine learning using a drone attached with hyperspectral and lidar sensors [11].

2. Research Questions

- Can lidar (DLS and TLS) be utilized to quantify and differentiate the structural differences between various chestnut hybrids (American, Chinese, American-Chinese backcross, and American-Chinese-Japanese)
- What is the threshold of genome content at which a chestnut tree will appear more structurally like the American or Chinese chestnut tree?
- Can machine learning of point cloud products classify a chestnut trees genome majority?

3. Previous Work

In a previous project for TACF, multiple point-cloud collection methods were attempted. An example of the point clouds for two different trees, stocky and thin, as well as the product of a point cloud in the form of a tree model reconstruction for the stocky tree can be seen here:

https://yckobayashi.github.io/. While the results have not been finalized, some preliminary conclusions can be made:

1. Scanning using a TLS produces the highest-resolution point cloud at the cost of time and manpower compared with DLS.
2. Due to the lack of objects with flat features in the scene, ground control targets set up specifically for lidar are required to assist in tying together the DLS and TLS point cloud for higher accuracy.
3. Collecting data during leaf off produces the best results for reconstructing a tree model and extracting branch and stem metrics.
4. Collecting data during leaf on produces lower quality results for reconstructing a tree model but may provide additional metrics on tree canopy health.

4. Methods

The methodology applied for this research is as follows:

i. Fly DLS over a research orchard of chestnut trees at Lesesne State Forest (approximately 10 ac), shown in figure 2.
ii. Collect lidar data from the ground at the same site using TLS.
iii. Fly another drone with a camera attached over the same area to take photographs
iv. Create an orthomosaic of the site using SfM with Agisoft Metashape (https://www.agisoft.com/).
v. Process the point cloud in R using a script which extracts the tree metrics (tree height, canopy diameter, etc.) and segments the individual trees.
vi. Process the individual tree point clouds in Computree (http://computree.onf.fr/?page_id=589) using the plugin SimpleForest (https://www.simpleforest.org/) and extract branch metrics (radius, length, branch order, height, etc.) for individual trees.
vii. Combine the branch metrics with the tree inventory dataset (which includes the genome distribution).
viii. Feed the complete dataset into a machine learning algorithm, such as simple regression or random forest, to determine the correlation between the genome content and tree and branch metrics and determine the explanatory factors most important in predicting genome content.

Figure 1: Virginia Department of Forestry Lesesne State Forest chestnut orchards (Nelson County, VA)

5. Expected Deliverables

With this project, we propose integrating remote sensing techniques to the ongoing research of phenotyping hybridized chestnut trees. Processing point clouds would allow for a quicker analysis of the relation between genotype and phenotype. We will be providing both TACF and VDOF an updated workflow for lidar processing.

The results of the machine learning analysis in this proposal will provide TACF and VDOF a novel avenue for faster and more accurate assessment of chestnut tree growth, structure, and (by extension) apparent competitive ability in the forest canopy, as well as unexplored correlations between hybrid ancestry and tree structure. To the wider chestnut community, the result will provide a threshold of genome to deepen the understanding of the tree phenotype due to hybridization.

In the long term, this collaboration will help TACF and VDOF adopt best practices in remote sensing which are now routinely applied in conservation-based and commercial silviculture. By the end of this project, we hope to have targeted an appropriate funding opportunity (e.g., USDA-NIFA) to develop a more complete proposal in collaboration with TACF scientists in order to continue this exciting line of research.

6. References

1. Hepting, G.H. Death of the American Chestnut. *https://doi.org/10.2307/3983346* **2021**, *18*, 60–67, doi:10.2307/3983346.
2. Rigling, D.; Prospero, S. Cryphonectria Parasitica, the Causal Agent of Chestnut Blight: Invasion History, Population Biology and Disease Control. *Molecular Plant Pathology* **2018**, *19*, 7–20, doi:10.1111/MPP.12542.
3. Steiner, K.C.; Westbrook, J.W.; Hebard, F. v.; Georgi, L.L.; Powell, W.A.; Fitzsimmons, S.F. Rescue of American Chestnut with Extraspecific Genes Following Its Destruction by a Naturalized Pathogen. *New Forests* **2017**, *48*, 317–336, doi:10.1007/S11056-016-9561-5/FIGURES/4.
4. Collis, R.T.H. Lidar. *Applied Optics, Vol. 9, Issue 8, pp. 1782-1788* **1970**, *9*, 1782–1788, doi:10.1364/AO.9.001782.
5. Dubayah, R.O.; Drake, J.B. Lidar Remote Sensing for Forestry. *Journal of Forestry* **2000**, *98*, 44–46, doi:10.1093/JOF/98.6.44.
6. Hackenberg, J.; Morhart, C.; Sheppard, J.; Spiecker, H.; Disney, M. Highly Accurate Tree Models Derived from Terrestrial Laser Scan Data: A Method Description. *Forests 2014, Vol. 5, Pages 1069-1105* **2014**, *5*, 1069–1105, doi:10.3390/F5051069.
7. Resop, J.P.; Lehmann, L.; Cully Hession, W. Drone Laser Scanning for Modeling Riverscape Topography and Vegetation: Comparison with Traditional Aerial Lidar. *Drones 2019, Vol. 3, Page 35* **2019**, *3*, 35, doi:10.3390/DRONES3020035.
8. Jakubowski, M.K.; Guo, Q.; Kelly, M. Tradeoffs between Lidar Pulse Density and Forest Measurement Accuracy. *Remote Sensing of Environment* **2013**, *130*, 245–253, doi:10.1016/J.RSE.2012.11.024.
9. Fritz, A.; Kattenborn, T.; Koch, B. UAV-Based Photogrammetric Point Clouds- Tree Stem Mapping in Open Stands in Comparison to Terrestrial Laser Scanner Point Clouds. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* **2013**, *XL-1/W2*, 141–146, doi:10.5194/ISPRSARCHIVES-XL-1-W2-141-2013.
10. Dungey, H.S.; Dash, J.P.; Pont, D.; Clinton, P.W.; Watt, M.S.; Telfer, E.J. Phenotyping Whole Forests Will Help to Track Genetic Performance. *Trends in Plant Science* **2018**, *23*, 854–864, doi:10.1016/J.TPLANTS.2018.08.005.
11. Vasilii Mosin, al; Aguilar, R.; Platonov, A.; Vasiliev, A.; Kedrov, A.; Ivanov, A.; Mosin, V. Remote Sensing and Machine Learning for Tree Detection and Classification in Forestry Applications. *https://doi.org/10.1117/12.2531820* **2019**, *11155*, 130–141, doi:10.1117/12.2531820.

H. Timeline

December 2022 – April 2023	• Collect DLS and TLS during the leaf-off season at the LSF orchards. • Collect drone-based aerial imagery during leaf off at the LSF orchards. • Process the images and produce an orthomosaic map. • Collect field measurements (branch length, distance to first branch, etc.) for reconstructed tree model verification. • Extract tree metrics from DLS and TLS point clouds. • Process tree point clouds to derive branch metrics. • Perform analyses using machine learning methods to determine the correlation between genome content and tree form.
June 2023 – November 2023	• Collect DLS and TLS during the leaf-on season at the LSF orchards. • Collect drone-based aerial imagery using during leaf off at the LSF orchards. • Process the images and produce an orthomosaic map. • Collect field measurements (branch length, distance to first branch, etc.) for reconstructed tree model verification. • Extract tree metrics from DLS and TLS point cloud. • Process tree point clouds to derive branch metrics. • Perform analyses using machine learning methods methods to determine the correlation between genome content and tree form. • Compare the lidar metrics produced during both leaf-off and leaf-on surveys to compare relative importance in predicting genome content.

I. Budget

Description	Unit Cost	Unit	Cost
Ground Control Target Set (4 targets, 4 mini tripods, 1 carry bag)	$ 2,500.00	1	$2,500.00
Drone Use Fee (per main flight)	$ 1,200.00	2	$2,400.00
Pilot/Lab Manager Effort (set-up, flight, post flight; 22 hr/flight)	$ 35.00	50	$1,750.00
Vehicle/Big Flights (BSE, 2 main flight trips - 2 vehicles)	$ 137.50	4	$ 550.00
Vehicle/Follow-up Visits (BSE, 2 additional trips - 1 vehicle)	$ 137.50	2	$ 275.00
MI&E ($44.25 per day/person, Big Flights = 5; Follow-up = 2)	$ 44.25	14	$ 619.50
Lodging (Dr. Resop, 1 room, $100/room, 2 trips)	$ 100.00	2	$ 200.00
Intern Wages	$ 15.00	100	$1,500.00
Total			$9,794.50

Budget Notes:

- *Y. Kobayashi time/effort not included (he will be on a George Washington Carver Assistantship)*
- *Dr. Hession time/effort not included (in-kind)*
- *Dr. Resop time/effort not included (he will assist with post processing and machine learning component)*

J. Brief CV of Principle Investigators (attached)

W. Cully Hession, PhD, PE
200 Seitz Hall, Virginia Tech, 155 Ag Quad Lane, Blacksburg, VA 24061
Phone: (540) 231-9480, E-mail: chession@vt.edu

Education

Date Awarded	Degree	Institution
1995	PhD, Biosystems Engineering	Oklahoma State University
1988	MS, Agricultural Engineering	Virginia Tech
1984	BS, Agricultural Engineering	Virginia Tech

Professional Appointments

Date Range	Position	Institution
2012-present	Professor, Biological Systems Engineering	Virginia Tech
2005-2012	Associate Professor, Biological Systems Engineering	Virginia Tech
2005	Associate Professor, Civil & Environmental Engineering	University of Vermont
1999-2005	Assistant Professor, Civil & Environmental Engineering	University of Vermont
1995-1999	Assistant Curator, Patrick Center for Environmental Research	Academy of Natural Sciences (Philadelphia)
1989-1992	Sr. Environmental Engineer	VA Dept. of Conservation & Rec. (Richmond, VA)
1986-1989	Assistant Scientist	USDA-ARS (Morris, MN)

Recent Relevant Funding

2022-2023, NOAA-RISA - $100,000 (co-PI), *Building Resilience to Climate Change Driven Extreme Weather Events in Appalachia* (Collaborators: Daniels/MSU PI; 14 co-PIs)

2022, The American Chestnut Foundation - $4,500 (PI), *Characterizing Chestnut Tree Structure through Remote-Sensing Applications* (Collaborators: Kobayashi)

2020-2022, Virginia Tech-ICAT - $25,000 (PI), *Virtual Watersheds: An Immersive Experience at the Confluence of Water and Society* (Collaborators: Polys, Sforza, Meaney, Drape)

2018-2022, USDAAFRI/Research and Extension Experience for Undergraduates - $278,911 (PI), *Training Future Leaders to Solve Resource Challenges at the Confluence of Water and Society* (Collaborators: Krometis, Badgley, Ling)

2020-2021, City of Roanoke, VA - $68,250 (co-PI), *A Case Study for Prioritizing Stream Restoration Efforts in the City of Roanoke* (Collaborators: Thompson, Entrekin)

2020-2021, Virginia Tech-OVPLSI - $5,000 (co-PI), *Monitoring Peak Creek, Pulaski, VA – Project Based Work with Local Employers* (Collaborators: Krometis)

2020-2021, Virginia Tech-GCC/Seed Grant - $20,000 (co-PI), *Innovative Particle Tracking to Quantify Soil Erosion and Sediment Transport Processes Under Global Change* (Collaborators: Stewart, McGuire, Polys)

Recent and Relevant Publications (*Graduate Student, **Undergraduate Student)

Christensen*, N.D., J.A. Czuba, S. Triantafillou**, C.A. Copenheaver, J.A. Peterson, and W.C. Hession (2022), Establishment and persistence of trees growing in the channel of an intermittent stream in a temperate, karst environment. *Water Resources Research*, 58, e2021Wr031528. doi/10.1029/2021WR031528

Sumnall, M.J., T.J. Albaugh, D.R. Carter, R.I. Cook, W.C. Hession, O.C. Campoe, R.A Rubilar, R.H. Wynne, and V.A. Thomas (2022), Effect of varied unmanned aerial vehicle laser scanning pulse density on accurately quantifying forest structure. *International Journal of Remote Sensing*, 43:2, 721-750. doi/10.1080/01431161.2021.2023229

Prior, E.M.*, C.A. Aquilina*, J.A. Czuba, T.J. Pingel, and W.C. Hession (2021), Estimating floodplain vegetative roughness using drone-based laser scanning and structure from motion photogrammetry. *Remote Sensing*, 13, 2616.

Resop, J.P., L. Lehmann, and W.C. Hession (2021), Quantifying the spatial variability of annual and seasonal changes in riverscape vegetation using drone laser scanning. *Drones*, 5, 91.

Govenor, H.*, W.C. Hession, T. Keys*, N. Jones*, R. Stewart, and L.H. Krometis (2021), Evaluating rare earth elements as tracers of fluvial processes: Fine sediment transport and deposition in a small stream. *Transactions of the ASABE*, 64(3), 905-918.

Wind, L.*, I. Keenum*, S. Gupta*, P. Ray*, K. Knowlton, M. Ponder, W.C. Hession, A. Pruden, L.H. Krometis (2021), Integrated metagenomic assessment of multiple pre-harvest control points on lettuce resistomes at field-scale. *Frontiers in Microbiology*, 12, 683410.

Wind, L.*, L.H. Krometis, W.C. Hession, and A. Pruden (2021), Cross-comparison of methods for quantifying antibiotic resistance in agricultural soils amended with dairy manure and compost. *Science of the Total Environment*, 766, 144321.

Lakoba, V.T.*, L. Wind*, S.E. DeVilbiss*, M.E. Lofton*, K.A. Bretz*, A.R. Weinheimer*, C.E. Moore*, C.A. Baciocco**, E.R. Hotchkiss, and W.C. Hession (2020), Salt dilution and flushing dynamics of an impaired agricultural−urban stream, *ES&T-Water*, 2021(1), 407-416.

Hession, W.C., L.T. Lehmann, L.L. Wind*, M.E. Lofton*(2020), High-frequency time series of stage height, stream discharge, and water quality for Stroubles Creek in Blacksburg, VA, USA 2013-2018 ver 1. *Environ. Data Initiative*.

Jacobs*, K., L. Wind*, L. Krometis, W.C. Hession, A. Pruden (2019), Fecal indicator bacteria and antibiotic resistance genes in storm runoff from dairy manure and compost-amended vegetable plots, *JEQ*, 48, 1038-1046.

Resop, J.P., L. Lehmann, W.C. Hession (2019), Drone laser scanning for modeling riverscape topography and vegetation: Comparison with traditional aerial lidar, *Drones*, 3(35).

Govenor*, H., L. Krometis, L. Willis, P.L. Angermeier, W.C. Hession (2019), Macroinvertebrate sensitivity thresholds for sediment in VA streams, *IEAM*, 15(1), 77-92.

Radolinski*, J., J. Wu*, K. Xia, W.C. Hession, R.D. Stewart (2019), Precipitation-driven transport of a neonicotinoid pesticide under field conditions, *Chemosphere*, 222, 445-452.

Keys*, T., H. Govenor*, C. Jones*, W.C. Hession, E. Hester, D.T. Scott (2018), Effects of large wood on floodplain connectivity in a headwater Mid-Atlantic stream, *Eco Eng,* 118, 134-142.

Yohtaro Kobayashi

900 Steading Ln, Blacksburg, VA 24060
Cell Phone: 915-799-2040
Email: yckobayashi@vt.edu

Education:
University of Texas at El Paso
Bachelor of Science in Civil Engineering
Graduated May 2018

University of Texas at El Paso
Master of Science in Environmental Engineering
Graduated August 2020

Thesis Title: *A Comparison of Data-Driven and Process-Based Modeling for Nutrient Estimation in a Eutrophic Reservoir*

Virginia Polytechnic Institute and State University
Doctor of Philosophy in Biological Systems Engineering
Expected Graduation 2025

Organizations:
Chi Epsilon Honor Society — May 2017-Present
American Society of Civil Engineers (ASCE) — January 2017-Present

Work Experience:
Teaching Assistant — September 2018-August 2020
UTEP Department of Civil Engineering

Research Assistant — September 2017-May 2018
UTEP - Center for Environmental Resource Management — June 2019-August 2019

Designed a preliminary Bayesian network model for salinity within the soil of farmland to assist in the decision making of farmers.
Assisted in preprocessing and postprocessing of data as well as the field work of projects involving an unmanned aerial vehicle.
Designed a method to record the images of the ground under the canopy of an orchard.
Processed the images taken by the method above to create a mosaic.

Student Technician — July 2019-September 2020
TAMU - Agrilife Extension

Maintained hardware and software for an unmanned aerial vehicle.
Performed analysis on data recorded by an unmanned aerial vehicle.

Research Associate — September 2020-August 2021

Conducted experiments with a hyperspectral camera and analyzed the data.
Developed a script in Python to assist in image alignment for hyperspectral images.

Graduate Research Assistant August 2021-Present
Virginia Tech Department of Biological Systems Engineering

Ongoing research using LiDAR to detect microtopography in the floodplain of a nearby stream.

Ongoing project using LiDAR on hybridized chestnut trees for analyzing the correlation between tree form and genotype.

Publications and Presentations:

Using a Bayesian Network Based Model to Improve Decision Making for Farms Dealing with Salinity
Sustainable Water Resources Symposium, 2018 [poster presentation]

A Bayesian Network Based Model for Decision Making on a Farm Scale Impacted by Salinity
Environmental & Water Resources Institute, 2018 [oral presentation]

Model to Improve Decision Making for Farms Dealing with Salinity in the South-West Region
International Environmental Modelling & Software Society, 2019 [oral presentation]

Improving the Output of a Farm Field Model Through Data Assimilation
Sustainable Water Resources Symposium, 2019 [poster presentation]

Grants, Awards, and Funded Proposals

Research Grant, The American Chestnut Foundation, $4500 June 2022

Curriculum Vitae

I certify that this curriculum vitae is a current and accurate statement of my professional record.

Signature **Date** August 1, 2022

I. Personal Information

I.A. Last Name, First Name, Middle Name, Contact Information

Resop, Jonathan Patrick
18905 Olney Mill Road
Olney, MD 20832
Phone: 301-452-7434
E-mail: resop@umd.edu
URL: https://geog.umd.edu/facultyprofile/Resop/Jonathan

I.B. Academic Appointments

July 2018 to Present	Senior Lecturer, Department of Geographical Sciences University of Maryland, College Park, MD
August 2013 to June 2018	Lecturer, Department of Geographical Sciences University of Maryland, College Park, MD
November 2010 to July 2013	Postdoctoral Research Associate Crop Systems and Global Change Laboratory USDA-ARS, Beltsville, MD

I.C. Educational Background

June 2010	Ph.D. in Biological Systems Engineering Virginia Tech, Blacksburg, VA
August 2006	M.S. in Biological Resources Engineering University of Maryland, College Park, MD
December 2004	B.S. in Computer Science University of Maryland, College Park, MD
May 2004	B.S. in Biological Resources Engineering University of Maryland, College Park, MD

II. Research, Scholarly, Creative and/or Professional Activities

II.A. Refereed Journals

II.A.1. Refereed Journal Articles

Resop, J. P., J. S. Cundiff, and R. D. Grisso. June 2022. "Central Control for Optimized Herbaceous Feedstock Delivery to a Biorefinery from Satellite Storage Locations." AgriEngineering. 4(2): 544-565.

Resop, J. P. and J. S. Cundiff. September 2021. "Assessment of Herbaceous Feedstock Supply for Locating Biorefineries in the Piedmont, USA." Biofuels, Bioproducts, and Biorefining. 16(1): 43-53.

Resop, J. P., L. Lehmann, and W. C. Hession. September 2021. "Quantifying the Spatial Variability of Annual and Seasonal Changes in Riverscape Vegetation Using Drone Laser Scanning." Drones. 5(3): 91.

Resop, J. P., L. Lehmann, and W. C. Hession. April 2019. "Drone Laser Scanning for Modeling Riverscape Topography and Vegetation: Comparison with Traditional Aerial Lidar." Drones. 3(2): 35.

Resop, J. P., D. H. Fleisher, D. J. Timlin, D. Mutiibwa, and V. R. Reddy. December 2016. "Climate, Water Management, and Land Use: Estimating Potential Potato and Corn Production in the U.S. Northeastern Seaboard Region." Transactions of the ASABE. 59(6):1539-1553.

Resop, J. P., W. C. Hession, and T. M. Wynn. July 2014. "Quantifying the Parameter Uncertainty in the Cross-sectional Dimensions for a Stream Restoration Design of a Gravel-bed Stream." Journal of Soil and Water Conservation. 69(4):306-315.

Resop, J. P., D. H. Fleisher, D. J. Timlin, and V. R. Reddy. January 2014. "Biophysical Constraints to Potential Production Capacity of Potato across the U.S. Eastern Seaboard Region." Agronomy Journal. 106(1):43-56.

Resop, J. P., D. H. Fleisher, Q. Wang, D. J. Timlin, and V. R. Reddy. November 2012. "Combining Explanatory Crop Models with Geospatial Data for Regional Analyses of Crop Yield using Field-scale Modeling Units." Computers and Electronics in Agriculture. 89(1):51-61.

Resop, J. P., J. L. Kozarek, and W. C. Hession. April 2012. "Terrestrial Laser Scanning for Delineating In-stream Boulders and Quantifying Habitat Complexity Measures." Photogrammetric Engineering and Remote Sensing. 78(4):363-371.

Resop, J. P., J. S. Cundiff, and C. D. Heatwole. February 2011. "Spatial Analysis to Site Satellite Storage Locations for Herbaceous Biomass in the Piedmont of the Southeast." Applied Engineering in Agriculture. 27(1):25-32.

Resop, J. P. and W. C. Hession. October 2010. "Terrestrial Laser Scanning for Monitoring Streambank Retreat: Comparison with Traditional Surveying Techniques." Journal of Hydraulic Engineering. 136(10):794-798.

II.B. Conferences, Workshops, and Talks

II.B.1. Non-Refereed Presentations

Resop, J. P. and W. C. Hession. August 2022. "Quantifying Annual and Seasonal Changes in Topographic and Vegetative Stream Metrics using Drone Laser Scanning: A Case Study of Stroubles Creek, Virginia" 2022 TUGIS Conference. Towson, Maryland.

Resop J. P., V. Lakoba, J. Westbrook, E. Jenkins, Y. Kobayashi, L. Lehmann, and W. C. Hession. June 2022. "Evaluating American Chestnut Blight Resistance using Drone Laser Scanning and Machine Learning Techniques" 2022 AEES Conference. Baltimore, Maryland.

II.C. Sponsored Research and Programs – Administered by the Office of Research Administration (ORA)

II.C.1. Grants

Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI), Instrumentation Discovery Travel Grant (IDTG), $1000, June 2018, **J.P. Resop**.

III. Teaching, Extension, Mentoring, and Advising

III.A. Courses Taught

Summer 2022	GEOG 626: Python Programming and GEE, Enrollment: 30
Summer 2022	GEOG 656: Programming and Scripting for GIS, Enrollment: 57
Spring 2022	GEOG 654: GIS and Spatial Modeling, Enrollment: 15
Spring 2022	GEOG 646: Introduction to Programming for GIS, Enrollment: 27
Winter 2021	GEOG 636: Programming for GIS using Python, Enrollment: 20
Winter 2021	GEOG 646: Introduction to Programming for GIS, Enrollment: 28
Fall 2021	BIOE 442: Programming and Data Analysis, Enrollment: 30
Fall 2021	GEOG 654: GIS and Spatial Modeling, Enrollment: 44
Fall 2021	GEOG 797: Professional Project (Capstone), Enrollment: 27

III.B. Teaching Awards

Spring 2022	Department Award - Outstanding Instructional Faculty
Spring 2020	Department Award - Outstanding Instructional Faculty

IV. Service and Outreach

IV.A. Committees, Professional & Campus Service

IV.A.1. Campus Service – Department

Fall 2020 to Present	Department Lecturer Committee Chair
Fall 2013 to Present	Department MS Advisory Committee
Fall 2013 to Present	Department GIS Teaching Team
Fall 2013 to Present	Department Remote Sensing Teaching Team
Winter 2019	Department Promotion Review Committee for Senior Lecturer
Winter 2016	Department Search Committee for Assistant Professor
Summer 2016	Reviewed Department PTK Promotion Policy for Lecturers
Winter 2015	Department Search Committee for Assistant Professor

IV.A.2. Campus Service – University

Fall 2022 to Present	University of Maryland Senator
Summer 2022	UMD TLTC Teaching and Learning Grants Reviewer
Fall 2020 to Present	University of Maryland University Senate IT Council
Fall 2020 to Present	Mentor for Advancing Professional Track Faculty Network
Fall 2020 to Present	College of Behavioral and Social Sciences Buddy Program
Spring 2020 to Present	University of Maryland Teaching and Learning Transformation Center (TLTC) Faculty Liaison
Summer 2018	University of Maryland Planning Committee for the 2018 Professional Track (PTK) Faculty Symposium
Summer 2017	University of Maryland Online Strategic Planning Committee