3D Morphometrics and Image Analysis Workshop

Location: University of Washington, Friday Harbor Marine Laboratories, San Juan Island, WA
Course Dates: August 22-29, 2021
Course Website: https://SlicerMorph.github.io/2021_Summer_Workshop
Application deadline: July 23rd, 2021 (11:59 PDT)
Online Application URL: **Summer-2021-application**
Admission notification: August 1st, 2021

Target Audience: Course is directed for graduate students, post-docs and junior faculty who are interested in conducting quantitative research into organismal form and function using 3D imaging. It is also appropriate for more established researchers who are looking for open-source alternatives to the proprietary pipelines they have been using. We anticipate more applicants than we can accommodate. Applicants whose host institution lacks such curriculum and/or resources might be given preference.

Course Contents and Structure: Course is a combination of formal didactics and computer labs that accompany the content. Guest lecturers will cover topics in theory of statistical shape analysis, applied imaging, and high-throughput image analysis. Labs will cover all aspects of conducting specimen-based research using 3D imaging. Practical topics (e.g., image processing and segmentation, visualization) will be taught using the open-source **3D-Slicer** visualization suite and the **SlicerMorph morphometrics toolkit** (statistical shape analysis) Additional lab topics include using 3D specimen repositories to obtain data, tools and methods for collaboration and reproducible research, introduction to data analysis through R/Python. Course material will be focused on volumetric (e.g., CT or microCT) 3D datasets, but will be equally applicable to data from 3D surface scanners. Tentative syllabus can be found in the next page.

Expectations from attendees: Course format will be highly collaborative, and labs will be done in small teams. Prior experience with the tools is not expected, but will positively impact the learning experience. Students are expected to come with a project (and/or bring a sample to be imaged with microCT) and present at the beginning and the conclusion of the workshop as lightning talks. Each attendee should bring a recent (last two years) laptop running Windows, Mac or Linux OSes (no netbooks or tablets). More information about computer requirements will be provided to the selected applicants.

Logistics: Selected applicants will be notified by August 1st. Due to the logistics of getting to the island and the pace of the workshop, partial attendance is not possible, and selected participants need to confirm their travel plans in two weeks or forfeit their admission. Participants will be housed at the shared dormitories on site. It is expected that the attendee will arrive at FHL by Sunday August 22nd PM and be present for the pre-course check-in/registration in the evening. Workshop will end Saturday evening. Attendees need to check out from dorms by noon the following day. Please consider these requirements when applying.

Course Fees and Travel Support: There are no course registration fees and all lodging and meals are covered thanks to generous support from the National Science Foundation Advances in Biological Informatics program (ABI-1759637, Adam Summers & Murat Maga). A limited number of scholarships to offset the cost of travel is available for under-represented minorities (URM) in STEM. Please indicate your interest during application.

Contact information: If you have any questions, please contact us at SlicerMorph@outlook.com and one of our course directors will respond to your inquiry.

Ready to apply? Submit your application. Please be prepared to give a short description of your research background, your career goals, your mentor's contact information (for non-faculty applicants) and provide a CV (two-page limit, NSF Biosketch format is preferred) as PDF. You will need an account registered with Google to upload documents.

	8/22	8/23	8/24	8/25	8/26	8/27	8/28	8/29
7:45-8:15		Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	
8:30-10:15		**Introduction** Maga **3D imaging** Summers	**Applied Imaging Concepts** Rolfe	**Introduction to Statistical Shape Analysis II: Semi-Landmarks and beyond** Rolfe	**ALPACA** Rolfe	**SlicerMorph Toolkit: Putting it all together** Diamond	**Work on your on data / TBD**	Brunch / Checkout
10:15-10:30		Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
10:30-12:15		Attendee project Presentations - Initial	**Slicer #3: Segmentation, mesh conversion**	**SlicerMorph # 1: Statistical Shape Analysis: Work with sample data**	**ALPACA: Work with sample data**	**Repetitive tasks, Scripting in Slicer**	**Work on your on data / TBD**	
12:15-12:45		Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	
1:00-3:00	Course check-in & Self-Paced Pre Course Lab (Dining Hall)	**Slicer #1: UI, overview of functionality, extensions, finding help**	**Introduction to Statistical Shape Analysis I: Landmark-based methods** Maga	**Template-based analysis and computational anatomy** Maga	**TBD**	**Statistical Shape Models in R** Maga	**Setting your own lab / Concluding remarks** SlicerMorph team	
3:00-3:15		Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
3:15-5.15		**Slicer #2: Data formats, getting data from M/S, saving**	**Slicer #4: Measurements and Visualization**	**SlicerMorph # 2: Statistical Shape Analysis: Work on your data**	**Integrating SlicerMorph with R**	**Data processing in R: Plotting, modeling**	Visualization Competition and Social	
6:00-6:30	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	

7:00-8:00		Smores on beach	Study Hall @Dining Hall -	Study Hall @Dining Hall -	Study Hall @Dining Hall -	Study Hall @Dining Hall -		

Instructors:

Murat Maga: is an associate professor at the University of Washington Department of Pediatrics, and a principal investigator at the Seattle Children's Research Institute Center for Developmental Biology and Regenerative Medicine. Murat is a broadly trained quantitative morphologist and is interested in genetics and morphometrics of craniofacial development in mammals. He is the lead PI on the SlicerMorph project and the co-director of the summer workshops that accompany the project.

Adam Summers: is a professor at the University of Washington's Department of Biology and the School of Aquatic and Fisheries Sciences. He is interested in the comparative biomechanics of vertebrates in general and fish in particular. He has a mission to microCT scan every fish species. He is a co-investigator of the SlicerMorph project, and the co-director of the summer workshops that accompany the project.

Doug Boyer: is an associate professor of paleontology at Duke University. He is also the founder and the director of the MorphoSource 3D specimen repository and a co-investigator of the SlicerMorph project.

Sara Rolfe: is the lead scientific programmer on the SlicerMorph project. Sara specializes in biomedical image analysis and holds a PhD in Computer Engineering from University of Washington.

Ezgi Mercan: is a research scientist at the Seattle Children's Craniofacial Center, where she applies statistical shape analysis and modeling to study 3D skull growth in craniofacial skeleton both in normal and patient populations. Ezgi holds a PhD in Computer Science from University of Washington.

Shan Shan: is a post-doctoral fellow at the Duke University Department of Evolutionary Anthropology. She works on developing new methods to establish landmark-free correspondence of biological shape and holds a PhD in Statistics also from Duke University.

Stefan Schlager: is an assistant professor of Anthropology in the Faculty of Medicine, Albert-Ludwigs-University Freiburg (Germany). He is the developer of R/morpho library for geometric morphometric analysis.

Synopsis of Lectures:

Morphometrics and Image Analysis: A general introduction to various 3D image modalities, their applications, limitations and how to extract quantitative information from 3D datasets.

Applied Imaging Concepts: This lecture will deal with some of the fundamental concepts in image processing and analysis, such as different types of image filters, segmentation, data visualization. Emphasis will be on the application.

Introduction to Statistical Shape Analysis I: Landmark-based methods: This lecture will introduce the fundamental concepts in 'geometric morphometrics', such as types of landmarks, superimposition, biological vs geometric homology, form vs shape space, nuisance parameters, Procrustes Analysis, distance metrics, decomposition of shape variance, visualization.

Introduction to Statistical Shape Analysis II: Semi-landmarks and beyond: This lecture will continue from the previous lecture and will deal with specific cases where anatomical landmarks are sparse or non-existent.

Template-based analysis and computational anatomy: This lecture will discuss how computational anatomy can facilitate high-throughput analysis in single species/population contexts by using non-linear image registration.

Application of SSA: Modeling growth: This lecture will focus on linear regression models used in geometric morphometric analysis. Concepts to be explored are size/shape relationship, allometry, modeling in shape space vs form space.

Auto3Dgm and landmark-free correspondence of biological form: We describe a new software tool for automatically spreading landmarks and aligning morphologically diverse samples representing homologous structures. We review the concept of homology and justify the method in that context.

Applications of SSA: Phylogenetics: This lecture provides an overview of using morphometrics in phylogenetic analyses.

Setting your own lab: Suggestions on IS/IT hardware investment and support for early career scientist who are planning to start a lab focused on 3D morphometrics.

NOTES:

Breakfast/Lunch/Dinner hours follow the FHL Dining Hall schedule. Note that Sunday Brunch is from 10:00 to 10:30. You can see sample menus at https://fhl.uw.edu/facilities-resources/fhl-dining-hall-menu/

All lectures and labs will take place in the Lecture Hall.

Study halls are intended for attendees to review the day's lectures and labs in their own pace, and also work on their own data. Instructors will be available to answer questions during study halls.

Funding acknowledgement:

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