Workshop 2022

March 21-25

5 days of DIPY Methods and dMRI Theory!

Schedule - DIPY Workshop 2022

- All times reported in Bloomington, Indiana Time (EDT / UTC - 4:00).
- Zoom links will be provided after registration.

  Free registration here https://dipy.org/workshops/dipy-workshop-2022
- Note that all Keynote Speakers will be presenting live.

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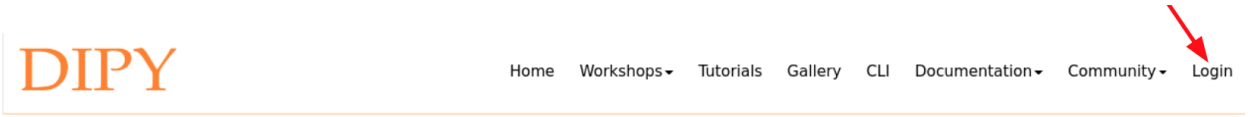
General Information

Summary

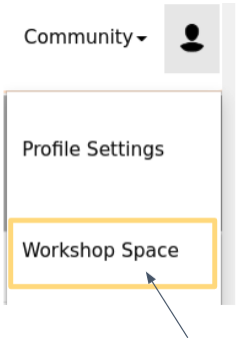
During this online workshop you will be able to attend a combination of live and pre-recorded educational talks. These will be available in your workshop space after registration and login into the dipy.org website. Each day in the workshop focuses on a different topic in the realm of Diffusion MRI with practical implementation and advanced theory sections. Each section will be followed by a live Q&A session where the speakers will dive deeper into the topic and answer your questions. For people who are new to DIPY, we recommend watching the talks in sequential order as reported in the schedule. Those who are already well familiar with DIPY can jump directly to the talks of their interest. The pre-recorded talks will be available at the beginning of the day.

How to Login

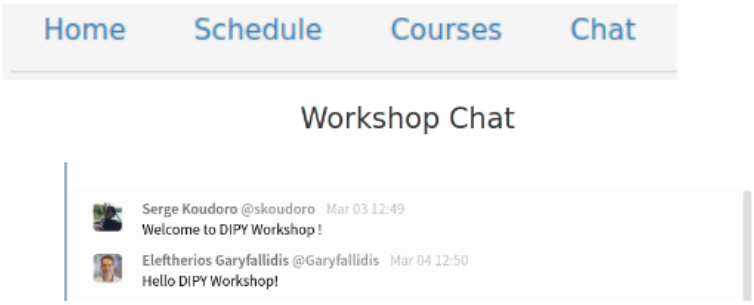
After registration. Please go to **https://dipy.org** and **Login** (located near the top right corner of the website). See below:



After logging in you go again at the top right where you see the black profile and select **Workshop Space**.



Then you can navigate and see the schedule, integrated chat and courses.



How to plan your week

Educational courses and tutorials
Available at 10 AM EDT (or earlier) for each day of the workshop.

Live Q&A sessions
Starts at 3 PM EDT - This is where you bring your questions after watching the videos of the day.

A Zoom link for this session is provided on the home page (with blue letters). See the red arrow below.

Schedule

Day 1 - Monday 21

10:00 am - **Workshop Overview & Installation Instructions**

Eleftherios Garyfallidis

Talk by Prof. Garyfallidis of Indiana University, Department of Intelligent Systems Engineering. Garyfallidis is the Workshop Chair, Founder, and Lead DIPY developer.

Synopsis Garyfallidis will clarify important points about DIPY and this workshop that the attendees should know. To follow the installation instructions make sure you have a recent Anaconda version installed.

10:20 am - **Visualize your data with DIPY Horizon**

Javier Guaje

Talk by Javier Guaje PhD candidate at Intelligent Systems Engineering.

Synopsis Horizon is DIPY's advanced 3D viewer. Among many features, it provides access to cinematic rendering capabilities by calling FURY functions. In this session, we will demonstrate how to use this exciting new tool. Javier is Horizon's lead contributor.

10:45 am - **Q&A for talks by Javier and Eleftherios.**

Note that additional Q&A time is provided at 15:00 pm.

11:00 am - **Introduction to computational neuroanatomy**


Wei Tang

Talk by Dr. Wei Tang of Indiana University, Department of Computer Science.

Synopsis Dr. Tang will explain the basic terminology that we will be using during the workshop and its connection to the actual neuroanatomy. Dr. Tang is an expert in monkey and human brain anatomy and data analysis.

11:45 am - **Q&A for the talk by Dr. Tang.**

Note that additional Q&A time is provided at 15:00 pm.

12:00 pm - **Diffusion Tensor Imaging (DTI)**


Ariel Rokem

Talk by Dr. Ariel Rokem of University of Washington, Seattle. Dr. Rokem is Associate DIPY Lead and a long time contributor to the project. Dr. Rokem is the inventor of the Sparse Fascicle Model and co-inventor of AFQ.

Synopsis Dr. Rokem will provide an introduction to DTI with DIPY. Learn how to extract a series of tensor derived maps. DTI was invented by Prof. Peter Basser.

12:20 pm - **Diffusion Kurtosis Imaging (DKI)**


Rafael Neto Henriques

Talk by Dr. Henriques of the Champalimaud Center of Unknown, Portugal.

Synopsis Dr. Henriques will explain Kurtosis Imaging methods available in DIPY. Dr. Henriques is the lead contributor to all Kurtosis related projects in DIPY.

12:45 am - **Q&A for talks by Dr. Rokem and Dr. Henriques**
Note that additional Q&A time is provided at 15:00 pm.

13:00 pm - **Denoising with Patch2Self**


Shreyas Fadnavis

Talk by PhD candidate, Shreyas Fadnavis of Indiana University. . Shreyas is the inventor of Patch2Self.

Synopsis Shreyas will explain how Patch2Self denoiser works and why it is more advantageous than existing denoisers. Shreyas will also talk about Matrix Sketching that is used in the most recent version of Patch2Self and NUQ which is a new approach to quantify noise uncertainty.

13:45 pm - **Q&A for the talk by Fadnavis**

Note that additional Q&A time is provided at 15:00 pm.

14:00 pm - **Data driven interference in diffusion MRI: Deep learning harmonization of quantitative brain biomarkers**


Bennett Landman

Keynote Speaker

Talk by Professor Bennett Landman of Vanderbilt University. Dr. Landman is Professor and Department Chair of Electrical and Computer Engineering at Vanderbilt University, with appointments in Computer Science, Biomedical Engineering, Radiology, and Radiological Sciences, Psychiatry and Behavioral Sciences, Biomedical Informatics, and Neurology.

Synopsis Prof. Landman will talk about his work in data harmonization and data-driven inference in Diffusion MRI. Dr. Landman has been a big proponent in supporting DIPY and has contributed multiple algorithms such as Histology-driven Deconvolution, Synb0-DisCo, etc. within the DIPY toolkit.

14:45 pm - **Q&A for the talk by Prof. Landman**

Note that additional Q&A time is provided at 15:00 pm.

15:00 pm - **Q&A session for the entire day**

Pose your questions to the speakers for the day

16:00 - 18:00 pm - **Live Demo Session**

Preprocessing - Gibbs suppression and Patch2Self denoising.
Be happy to try this method with your data.

Day 2 - Tuesday 22

10:00 am - **Spherical Harmonics**


Maxime Descoteaux

Talk by Prof. Descoteaux of University of Sherbrooke, Department of Computer Science, Canada. Prof. Descoteaux is the inventor of Analytical QBall modeling.

Synopsis Spherical harmonics are the basics of many important operations in dMRI analysis. Prof. Descoteaux will

10:20 am - **ODFs, QBall, CSD, SHORE, MAPMRI**


Eleftherios Garyfallidis

Talk by Prof. Garyfallidis.

Synopsis In this talk Prof. Garyfallidis will cover a series of reconstruction models that are using spherical harmonics and are available in DIPY.

10:45 am - **Q&A for talks by Maxime and Eleftherios.**

Note that additional Q&A time is provided at 15:00 pm.

11:00 am - **RUMBA-SD**

Talk by Dr. Canales-Rodrigues (EPFL, Switzerland) and Kenji Marshall (McGill University, Canada).

Synopsis Dr. Canales-Rodriguez is the inventor of RUMBA-SD. RUMBA-SD stands for Robust and Unbiased Model-BAsed Spherical Deconvolution. RUMBA can be used for identifying robust fiber ODFs but also partial volume effects among many other interesting properties. Kenji will discuss his RUMBA implementation available in DIPY.

Erick Jorge Canales-Rodríguez

Kenji Marshall

Keynote Speakers

11:45 am - **Q&A for talks by Dr. Canales-Rodrigues and Mr. Marshall.**

Note that additional Q&A time is provided at 15:00 pm.

12:00 am - **Microstructure Modeling**

Talk by Dr. Henriques of the Champalimaud Center of the Unknown, Portugal. Dr. Henriques is the inventor of CTI.

Synopsis Dr. Henriques will give an introduction to diffusion microstructure modeling and explain the techniques available in DIPY. In addition, he will talk about his recent invention, Correlation Tensor Imaging (CTI). Dr. Henriques has been leading the efforts in providing DIPY with microstructure modeling capabilities.

Rafael Neto Henriques

12:45 am - **Q&A for talk by Dr. Henriques.**

Note that additional Q&A time is provided at 15:00 pm.

13:00 pm - **Q-space Trajectory Imaging**

Leevi Kerkelä

Keynote Speaker

Talk by Dr. Kerkela of University College London, United Kingdom.

Synopsis Q-space Trajectory Imaging is a new imaging method that was invented by Prof. Carl-Fredrik Westin. The novel methods explore the power of time-varying gradients that probe trajectories in q-space, which is termed “q-space trajectory imaging” (QTI). QTI has the potential to make available a range of new measures with greater sensitivity and specificity to the nature of tissue structure and pathology in the human brain. Dr. Kerkela is a QTI expert who designed and programmed QTI in DIPY. Dr. Kerkela will talk about the theory of QTI and explain how to apply it to new data.

13:45 pm - **Q&A for the talk by Dr. Kerkela**

Note that additional Q&A time is provided at 15:00 pm.

14:00 pm - **Optimization constraints for diffusion MRI (MAP+, QTI+, CSD+, DKI+, …)**

Tom Dela Haije

Keynote Speaker

Prof. Haije of the University of Copenhagen will talk about his recent invention to improve the feasibility of fitting dMRI models.

Synopsis Prof. Haije will introduce the concept of semidefinite programming and explain how this can be applied to a series of different models improving fitting ability and statistical prediction. This is a talk on the importance of constrained optimization for dMRI analysis. Dr. Haije will explain how to improve our models moving forward.

14:45 pm - **Q&A for the talk by Prof. Haije**

Note that additional Q&A time is provided at 15:00 pm.

15:00 pm - **Q&A session for the entire day**

Pose your questions to the speakers for the day

16:00 - 18:00 pm - **Live Demo Session**

Reconstruction - Apply a range of reconstruction methods and look at their maps/metrics.

Be happy to try the method with your data and get direct feedback.

Day 3 - Wednesday 23

10:00 am - **Tractography**


Gabriel Girard

Dr. Gabriel Girard from CIBM Center for Biomedical Imaging, CHUV, and EPFL (Switzerland), will talk about the extensive tractography tooling in DIPY.

Synopsis Dr. Girard will teach how to perform tractography using DIPY via different approaches such as deterministic, probabilistic, and particle filtering tractography (PFT). Dr. Girard will provide tutorials with sample data he will go through practical applications, feasibility, and best practices for tracking. Dr. Girard is the inventor of PFT.

10:25 am - **Structural Connectivity**


Etienne St-Onge

Dr. St-Onge from McGill University will explain how one can perform structural connectivity analysis

Synopsis Dr. St-Onge will cover graph analysis via structural connectivity. This talk will explain the steps involved in getting the connectivity matrix from tractography data. Dr. St-Onge is the inventor of SET (surface-enhanced tractography).

10:45 am - **Q&A for talks by Girard and St-Onge.**
Note that additional Q&A time is provided at 15:00 pm.

11:00 am - **Parallel Transport Tractography**

Baran Aydogan

Keynote Speaker

Prof. Baran Aydogan from Eastern Finland university will talk about Parallel Transport Tractography (PTT).

Synopsis His keynote talk will explain in detail the new tracking approach using parallel transport tractography. The tool is soon to be integrated into DIPY. He will explain the advantages of the algorithm over existing approaches and the problems it solves. Dr. Aydogan is the inventor of PTT.

11:45 am - **Q&A for the talk by Dr. Baran**

Note that additional Q&A time is provided at 15:00 pm.

12:00 am - **Understanding Tractography File Formats and Reference Spaces**

François Rheault

Dr. François Rheault from Vanderbilt University will explain different types of file formats from tractography data.

Synopsis Dr. Rheault will talk about different storage formats for tractography data. He will talk in detail about different approaches unifying file formats and managing tractography analyses. It will explain how one can harmonize these formats and build a combined representation from them. Dr. Rheault is the inventor of Tractostorm.

12:45 am - **Q&A for the talk by Dr. Rheault.**

Note that additional Q&A time is provided at 15:00 pm.

13:00 pm - **Automatic segmentation and registration of bundles**

Eleftherios Garyfallidis

Dr. Eleftherios Garyfallidis, DIPY Lead and creator, Assistant Professor of Intelligent Systems Engineering at Indiana University Bloomington.

Synopsis Dr. Garyfallidis will talk about unsupervised white matter tractography clustering with QuickBundles (QB), minimally supervised white matter tract extraction with RecoBundles (RB), and affine registration of white matter tracts and whole-brain tractograms with streamline based

linear registration (SLR). Dr. Garyfallidis is the inventor of these 3 methods QB, RB, and SLR.

13:45 pm - **Q&A for the talk by Prof. Garyfallidis**
Note that additional Q&A time is provided at 15:00 pm.

14:00 pm - **Deep learning for white matter parcellation**

Prof. Lauren O'Donnell from Harvard will talk about the recently proposed deep learning parcellation method Superficial White Matter Analysis.


Lauren J. O'Donnell
Keynote Speaker

Synopsis SupWMA is a deep learning-based white matter parcellation method that uses a point cloud-based network to get the superficial white matter parcellations out of the tractography data. Prof. O'Donnell has invented multiple methods including the first automatic tractography segmentation paper using spectral embedding.

14:45 pm - **Q&A for the talk by Prof. O'Donnell**

Note that additional Q&A time is provided at 15:00 pm.

15:00 pm - **Q&A session for the entire day**

Pose your questions to the speakers for the day

16:00 - 18:00 pm - **Live Demo Session**

Tracking and Tractography extraction example.
Be happy to try the methods with your data and get direct feedback.

Day 4 - Thursday 24

10:00 am - **Tractometry and BUAN**

Bramsh Qamar Chandio

Talk by Bramsh Chandio, PhD Candidate in the Dept of Intelligent Systems Engineering at Indiana University Bloomington. .

Synopsis Bramsh will talk about tract analysis of white matter tracts (tractometry) to find microstructural changes in white matter across different population groups. The talk will be focused on the BUndle ANalytics (BUAN) framework. This session will also feature a BUAN demo applied to Parkinson's data (PPMI). Ms. Chandio is the inventor of BUAN.

10:45 am - **Q&A for the talk by Bramsh Chandio**
Note that additional Q&A time is provided at 15:00 pm.

Jaroslaw Harezlak

11:00 am - **Statistical analysis and group analysis**

Talk by Dr. Jaroslaw Harezlak, Professor in the Department of Epidemiology and Biostatistics at the Indiana University School of Public Health in Bloomington. Dr. Harezlak is DIPY's advisor on statistics.

Synopsis Dr. Harezlak will discuss statistical methods in DIPY's tractometry pipeline, BUAN. This session will focus on the basics and concepts of Linear Mixed Models and how BUAN incorporates them to find microstructural group differences in white matter tracts.

11:45 am - **Q&A for the talk by Dr. Jaroslaw Harezlak**
Note that additional Q&A time is provided at 15:00 pm.

12:00 pm - **Population-specific Bundle Atlasing**

Talk by David Romero, PhD candidate in Biomedical Engineering at Mondragon Unibertsitatea. Mr. Romero was a Google Summer of Code student for DIPY in 2021.

Synopsis Mr. Romero will discuss DIPY's new population-specific bundle atlasing method, BundleAtlasing. David will go through the concepts of template creation and will explain the BundleAtlasing method to automatically create white matter tract atlases. He will also talk about his new approach to improve affine streamline-based registration.

David Romero-Bascones

12:45 pm - **Q&A for the talk by David Romero**
Note that additional Q&A time is provided at 15:00 pm.

13:00 pm - **BundleWarp, nonrigid registration of white matter tracts**

Bramsh Qamar Chandio

Talk by Bramsh Chandio, PhD Candidate in the Dept of Intelligent Systems Engineering at Indiana University Bloomington.

Synopsis Bramsh will talk about DIPY's new streamline-based nonrigid registration method for white matter tracts, BundleWarp. In this session, we will explore how you can control the amount of deformations in your registration using BundleWarp.

13:45 pm - **Q&A for the talk by Bramsh Chandio**
Note that additional Q&A time is provided at 15:00 pm.

Kurt G Schilling

Keynote Speaker

14:00 pm - **Challenges in diffusion MRI tractography**

Talk by Dr. Kurt Schilling, Research Assistant Professor at Vanderbilt University.

Synopsis Dr. Schilling will discuss challenges in diffusion MRI tractography. How different factors such as scanners, tractography, and bundle segmentation methods play a role in final segmentation of white matter tracts. Dr. Schilling is the creator of multiple methods used in dMRI such as Synb0-DisCo and has great expertise in dMRI analysis and acquisitions.

14:45 pm - **Q&A for the talk by Dr. Kurt**
Note that additional Q&A time is provided at 15:00 pm

15:00 pm - **Q&A session for the entire day**

Pose your questions to the speakers for the day
16:00 - 18:00 pm - **Live Demo Session**

BUAN + BundleWarp + BundleAtlasing
Be happy to try the methods with your data and get direct feedback.

Day 5 - Friday 25

10:00 am - **Image-based registration and motion correction**


Serge Koudoro

Talk by Serge Koudoro, Indiana University. Mr. Koudoro is the release manager for DIPY. He is a software engineer with great expertise in image processing and registration.

Synopsis This talk will provide insights into the internal workings of the image registration modules in DIPY. Both affine and nonrigid registration will be covered along with some great tips for motion correction. Motion correction uses registration as one of its more prominent steps.

10:45 am - **Q&A for the talk by Serge Koudoro.**

Note that additional Q&A time is provided at 15:00 pm.

11:00 pm - **Removing SoS noise with CNNs**


Hu Cheng

Talk by Dr. Hu Cheng, Indiana University, Department of Psychological and Brain Sciences. Dr. Cheng is an MR Physicist and Senior Scientist with over a decade of experience in data acquisition and analysis.

Synopsis In this talk Dr. Cheng will present a new method for removing the sum of squares noise from diffusion MRI data using convolutional neural networks.

11:20 pm - **Brain Extraction using V-Net and CRF layers**

Talk by Jong Sung Park of Indiana University, Department of Intelligent Systems Engineering and Program in Neuroscience.

Synopsis In this talk Mr. Park will present a new method for performing brain extraction using deep learning with V-Net and conditional random fields.


Jong Sung Park

11:45 am - **Q&A for the talk by Dr. Cheng and Mr. Park.**

Note that additional Q&A time is provided at 15:00 pm.

12:00 am - **Intravoxel Incoherent Motion (IVIM)**

Talk by PhD candidate, Shreyas Fadnavis, Indiana University, Department of Intelligent Systems Engineering. Shreyas is the creator of TopoPro which will be used in this talk.


Shreyas Fadnavis

Synopsis IVIM is a method originally developed by Le Bihan that allows separating diffusion and perfusion components with dMRI data. In this talk, Shreyas will discuss a new method for optimization and fitting the IVIM model.

12:45 am - **Q&A for talk by Shreyas Fadnavis.**

Note that additional Q&A time is provided at 15:00 pm.

13:00 pm - **Tissue Classification**


Hu Cheng

Talk by Dr. Cheng Hu, Indiana University, and Dr. Julio Villalon from the University of Southern California.

Synopsis In the first part of the talk we will hear about Markov Random Fields applied to solve T1 classification problems (separating gray matter, CSF, and white matter). In the second part, we will hear about tissue classification using dMRI data (without the need for a T1).

13:45 pm - **Q&A for the talk by Dr. Hu and Dr. Villalon**


Julio Villalon

Note that additional Q&A time is provided at 15:00 pm.

14:00 pm - **QSIPrep – Preprocessing pipeline for Diffusion MRI**


Matt Cieslak

Keynote Speaker

Dr. Cieslak from the University of Pennsylvania will present QSIPrep which is a novel preprocessing pipeline for Diffusion MRI data.

Synopsis Dr. Cieslak will talk about the different capabilities provided by QSIPrep to perform denoising, eddy-current correction, susceptibility, and other standard preprocessing tools used as a standard practice in diffusion MRI analysis. QSIPrep uses DIPY as a backend and provides advanced capabilities to run the reconstruction and connectivity analysis pipeline. Dr. Cieslak is also the inventor of SHORELine which is a preprocessing method for eddy correction.

14:45 pm - **Q&A for the talk by Dr. Cieslak**
Note that additional Q&A time is provided at 15:00 pm.

15:00 pm - **Q&A session for the entire day**

Pose your questions to the speakers for the day

16:00 - 18:00 pm - **Live Demo Session**

Pipelines that run DIPY - Learn how to run a pyAFQ and QSIPrep pipeline.