

Software infrastructure for data driven science

- The need (unstructured data)

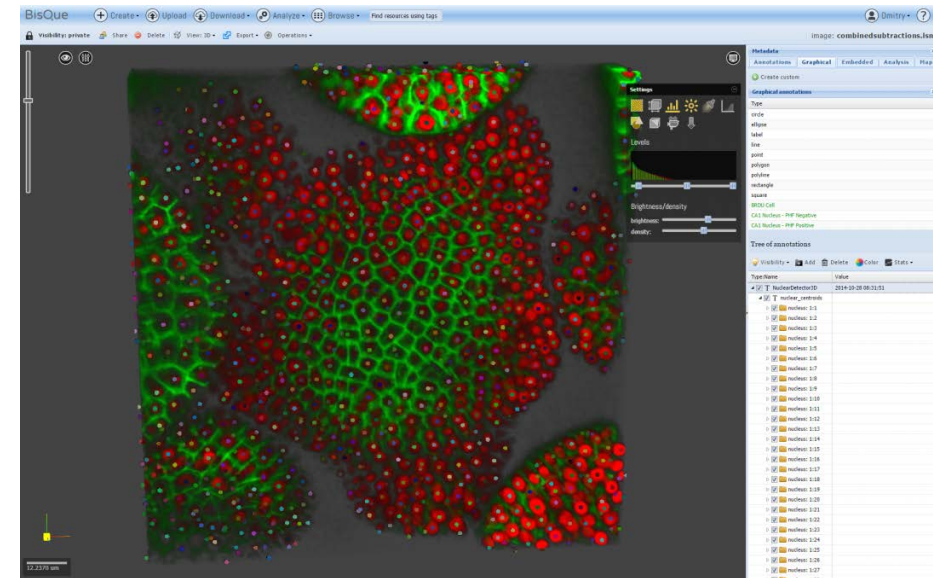
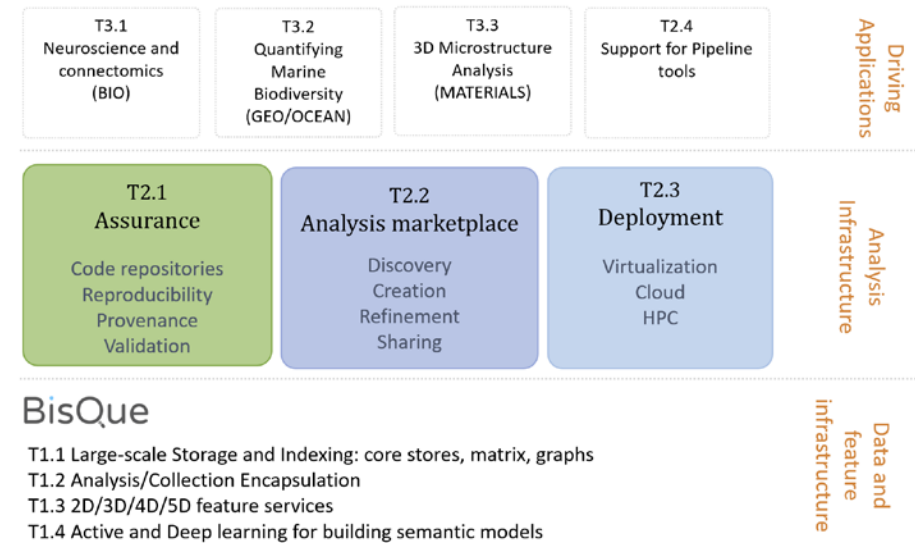
- Scalability and Reproducibility
- Robustness
- Sharing data and methods
- Complex tasks involve human guidance: annotations

- Introduction to Bisque

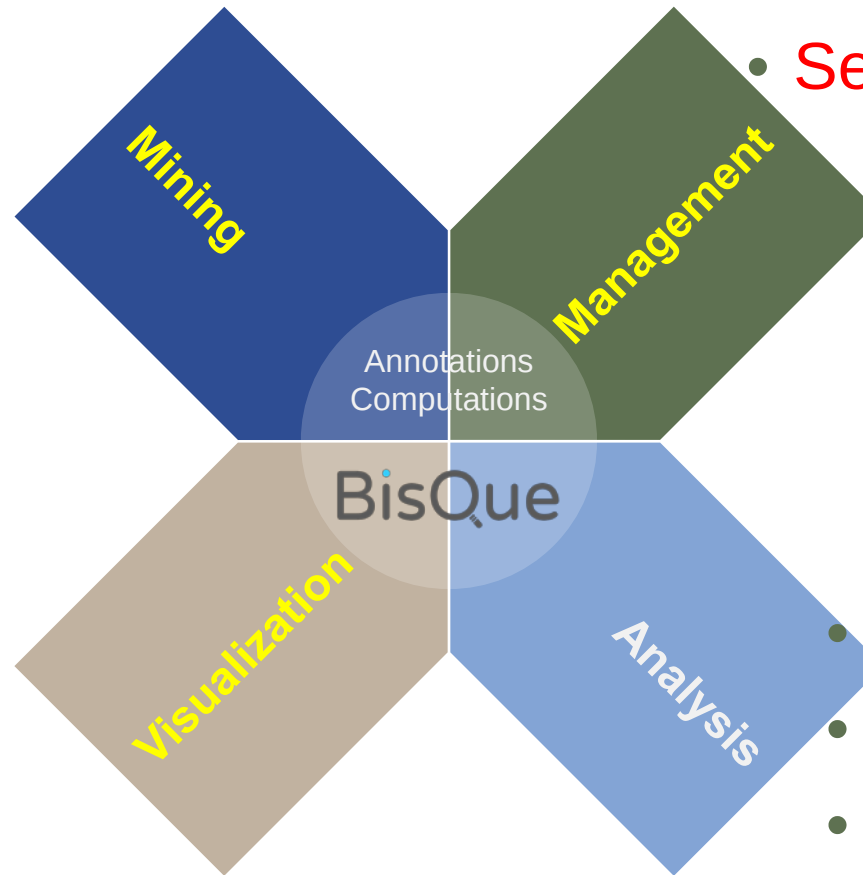
- Open source platform: 10+ years of development
- Unique capabilities: web-based image management & discovery environment
- Deep learning integration: leverages integrated information infrastructure and computational resources

BisQue Overview

- Management, analysis, and sharing of images and metadata for large-scale data science
- Flexible and scalable query system across network of multimodal data items
- Module system for scalable integration of analysis tasks over images and metadata
- 200+ life science image and video formats
- Analysis marketplace: easy sharing and discovery of analysis modules
- More information on BisQue: <http://bioimage.ucsb.edu/bisque>



- Multimodal: Textual, 5D graphical, images, graph, geometry
- Semantic meaning



- 250+ image formats
- Everything on the web
- Searchable & organizable

- 5D images of any size
- WebGL volume viewer
- Many types: images, molecules, PDFs, etc...
- Plots and summaries

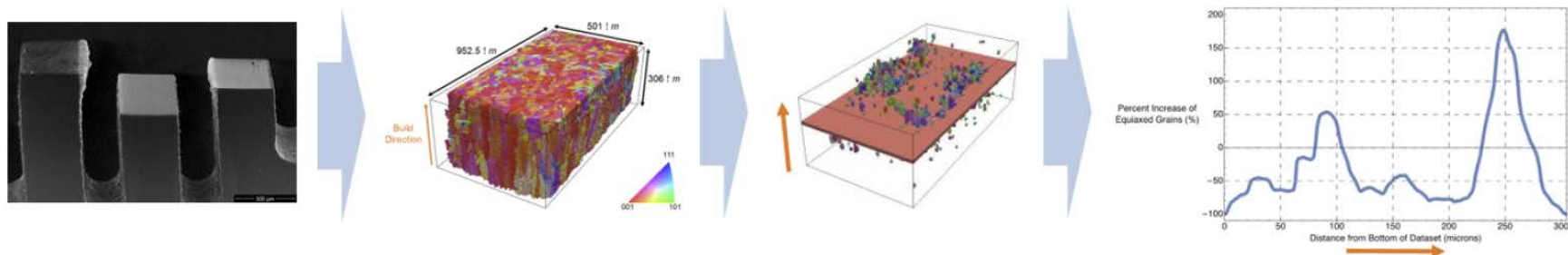
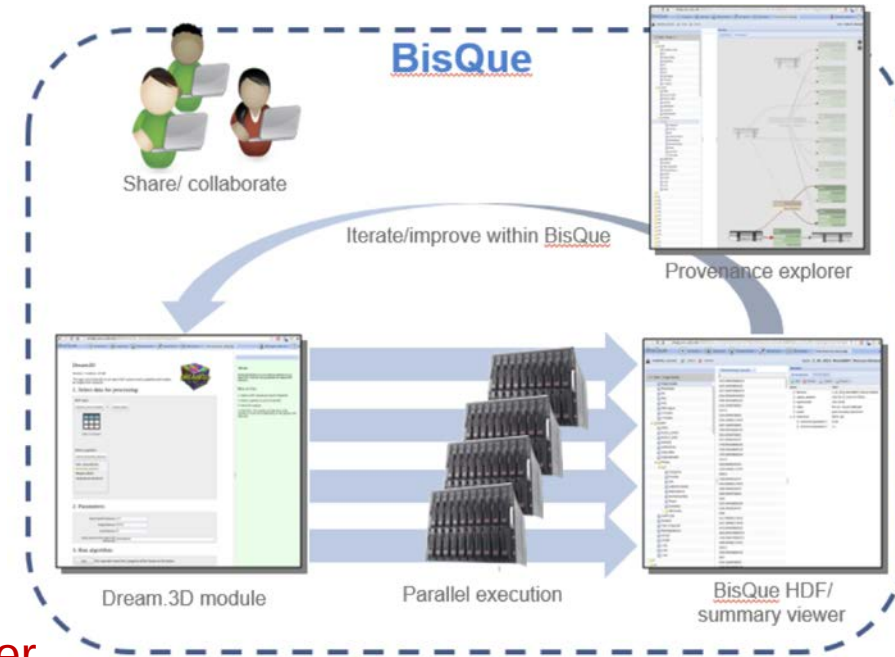
- Large-scale & extensible
- Automated UI
- Docker deployments
- Python, ITK, Matlab, CellProfiler, DREAM.3D,

...

Dream.3D Integration

(Use Case: Materials Structure Analytics)

- Large acquired Materials Science datasets analyzed in desktop apps such as Dream.3D
- Dream.3D pipelines and execution integrated in BisQue
- Datasets and pipelines can be **shared with collaborators**
- Parameter variations are **parallelized** over compute grid
- Large datasets **viewable in web browser**
- **Provenance tracking** for improved repeatability



Microstructure analysis

- Integration of open-source Dream.3D into BisQue
- Creation of workflows in BisQue using Dream.3D analysis modules
- Dream.3D now available as a module in the production instance at Cyverse and at UCSB

REF:

[Polonsky et al., Integr. Mater. Manufact. Innov., 2019](#)

Data-driven relationships

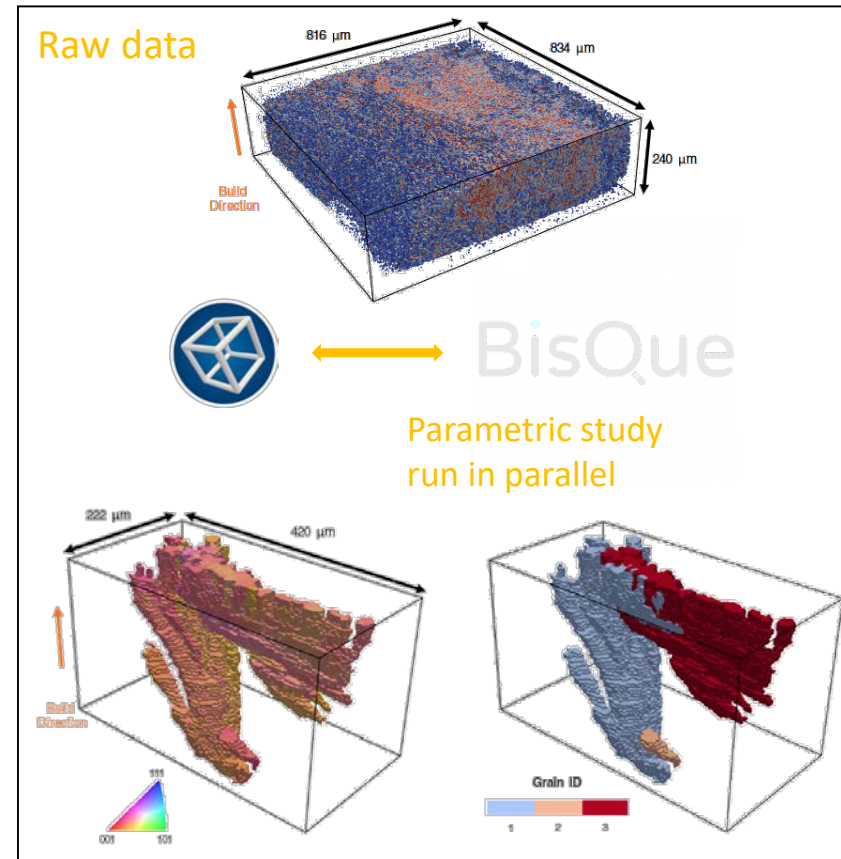
microstructure-property

- Developed a data-driven module for predicting properties of two-phase composite materials given their 3D mesoscale structure
- Module available in BisQue for other researchers

REF:

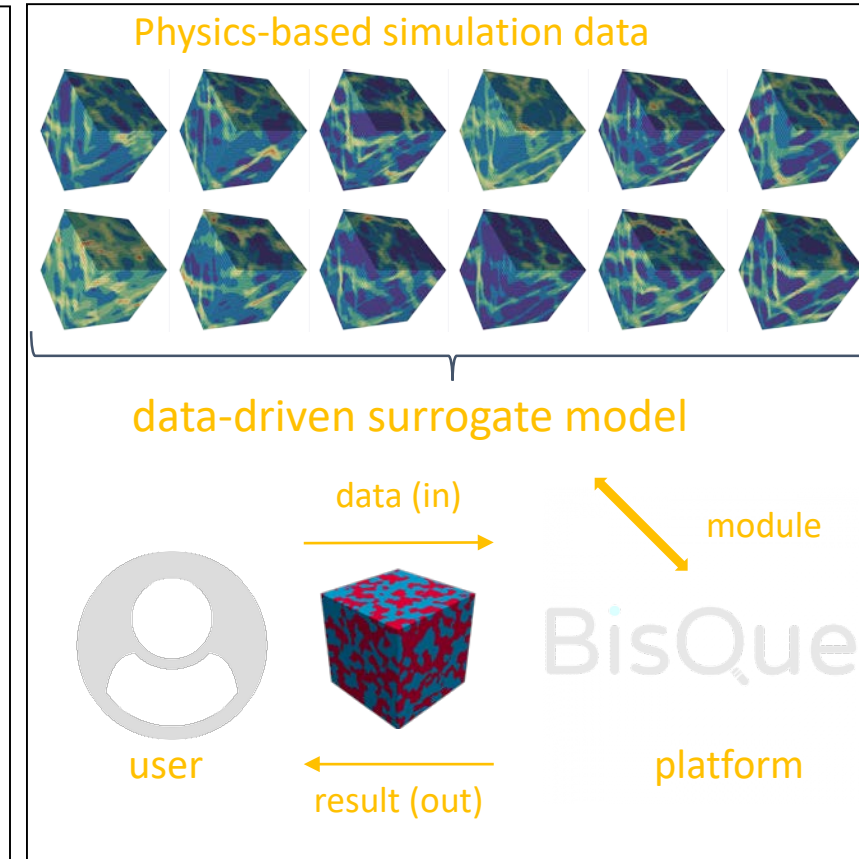
[Latypov et al., Integr. Mater. Manufact. Innov., 2019](#)

Microstructure analysis



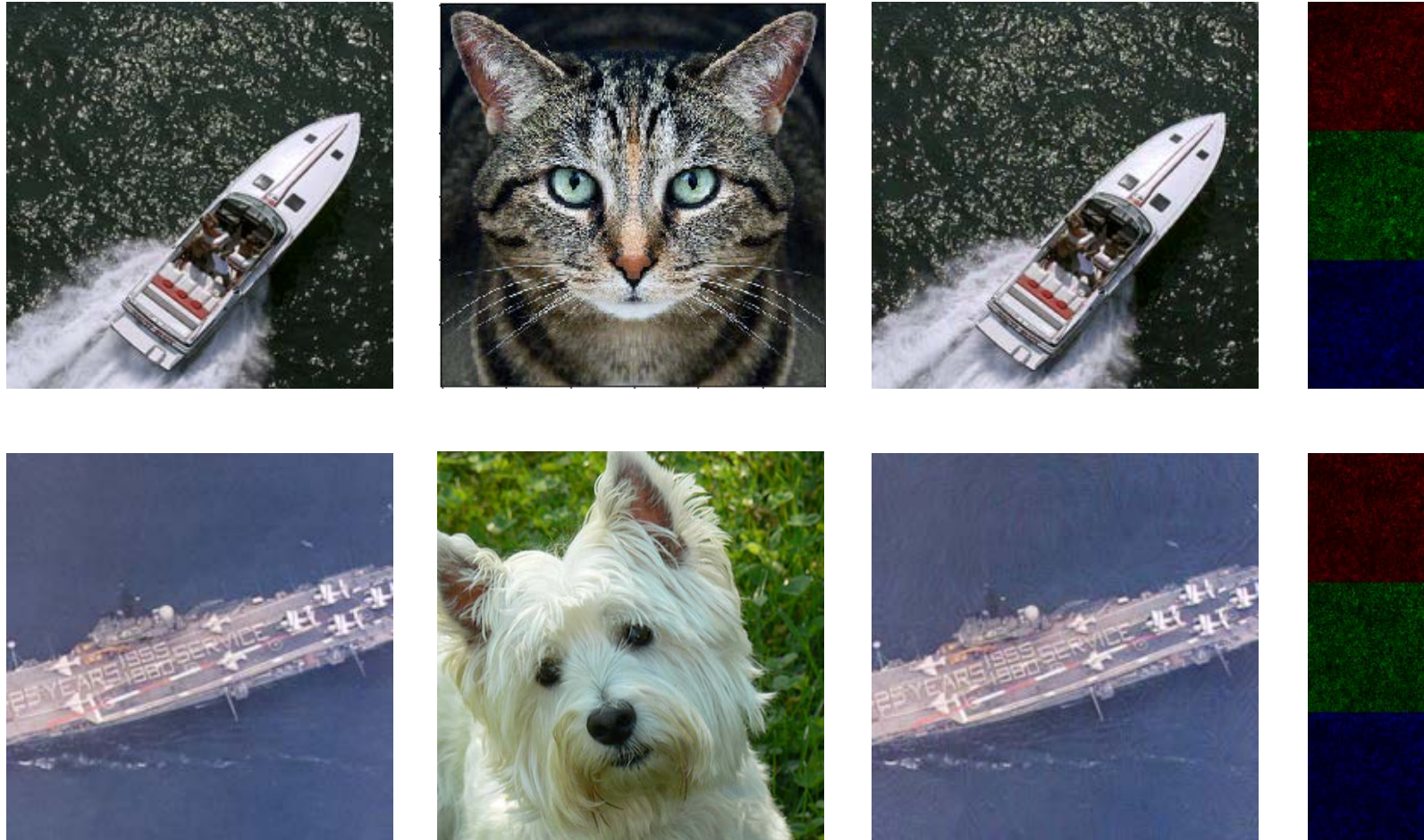
https://bisque.ece.ucsb.edu/module_service/Dream3D

Microstructure analysis



https://bisque.ece.ucsb.edu/module_service/Composite_Strength/

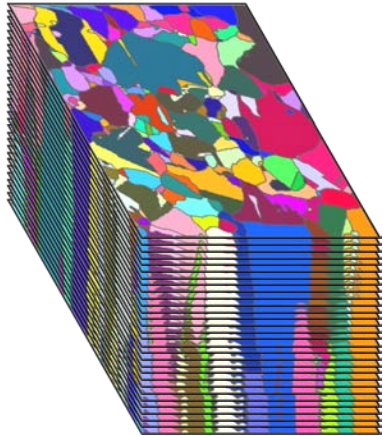
Going cats and dogs



Examples of neural network being fooled.
(1st column) original overhead boat and aircraft carrier image that were correctly classified;
(2nd column) the cat/dog target-label image;
(3rd column) the image with visually imperceptible modifications that is misclassified by AlexNet with high confidence;
(4th column) the per-channel difference between the images in 1st and 3rd column.

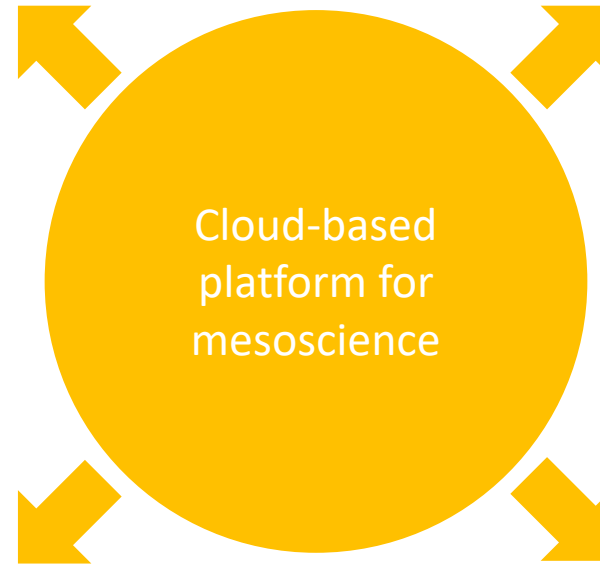
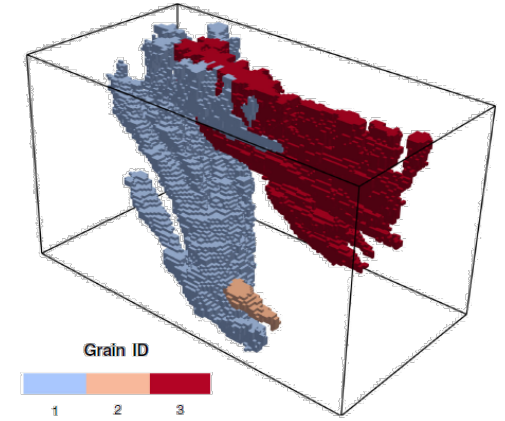
Moving forward: 3D mesoscience

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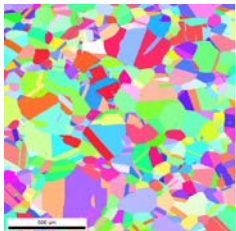
- Storage
- Sharing
- Provenance
- API

- 3D reconstruction
- 3D analysis
- 3D visualization



Cloud-based
platform for
mesoscience

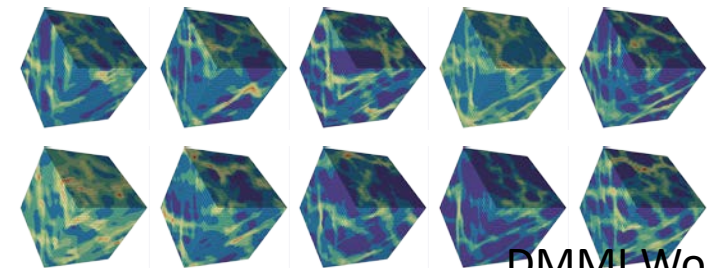
exp



- Deep learning
- Generative modeling

- Physics-based modeling
- Statistical learning

synthetic



July 16, 2019

UCSB/Manjunath

DMMI Workshop Panel