

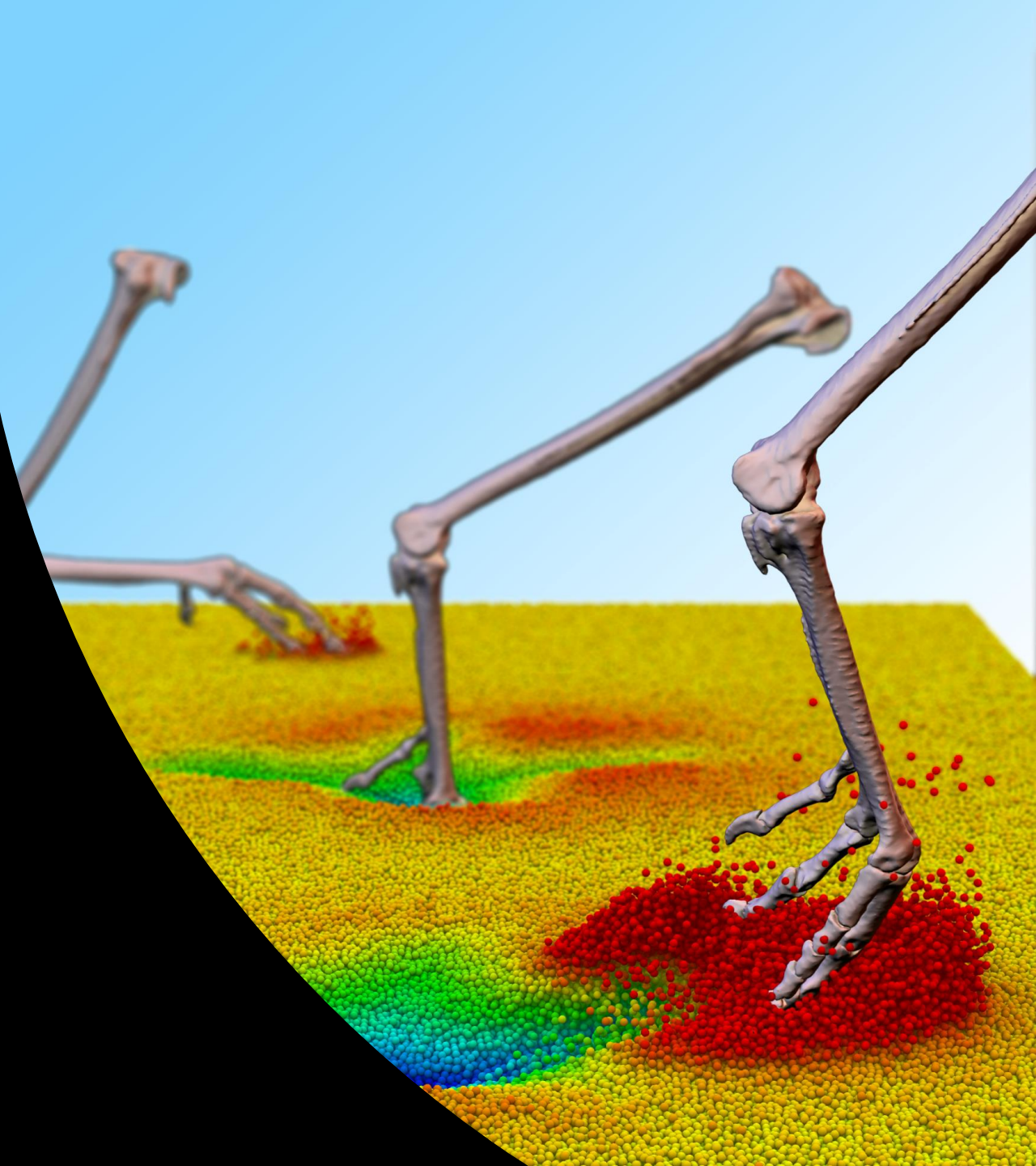
Peter Falkingham

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*Bi-planar X-ray imaging  
and HPC simulation of  
dinosaur footprint  
formation*

<https://peterfalkingham.com>

@peterfalkingham

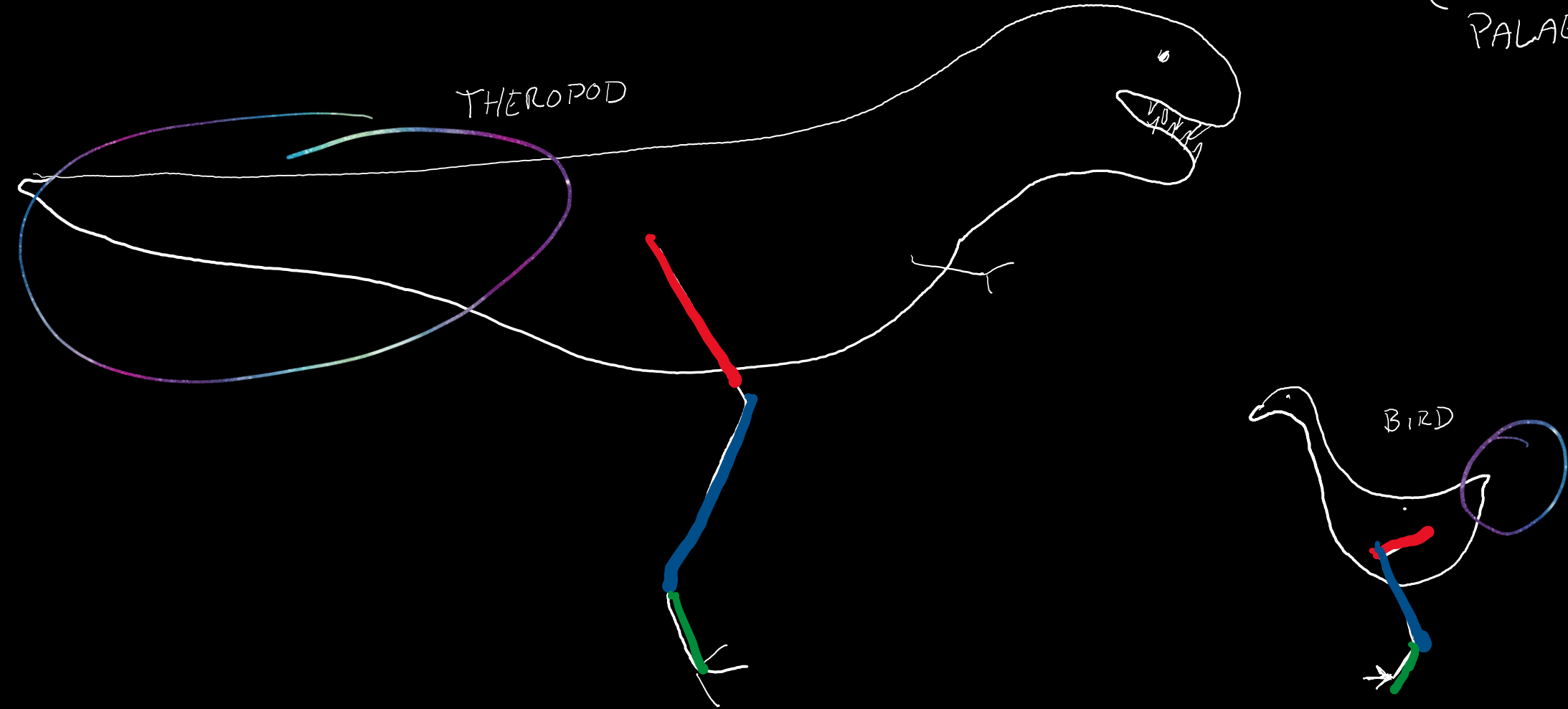


# Dinos to birds – locomotor evolution

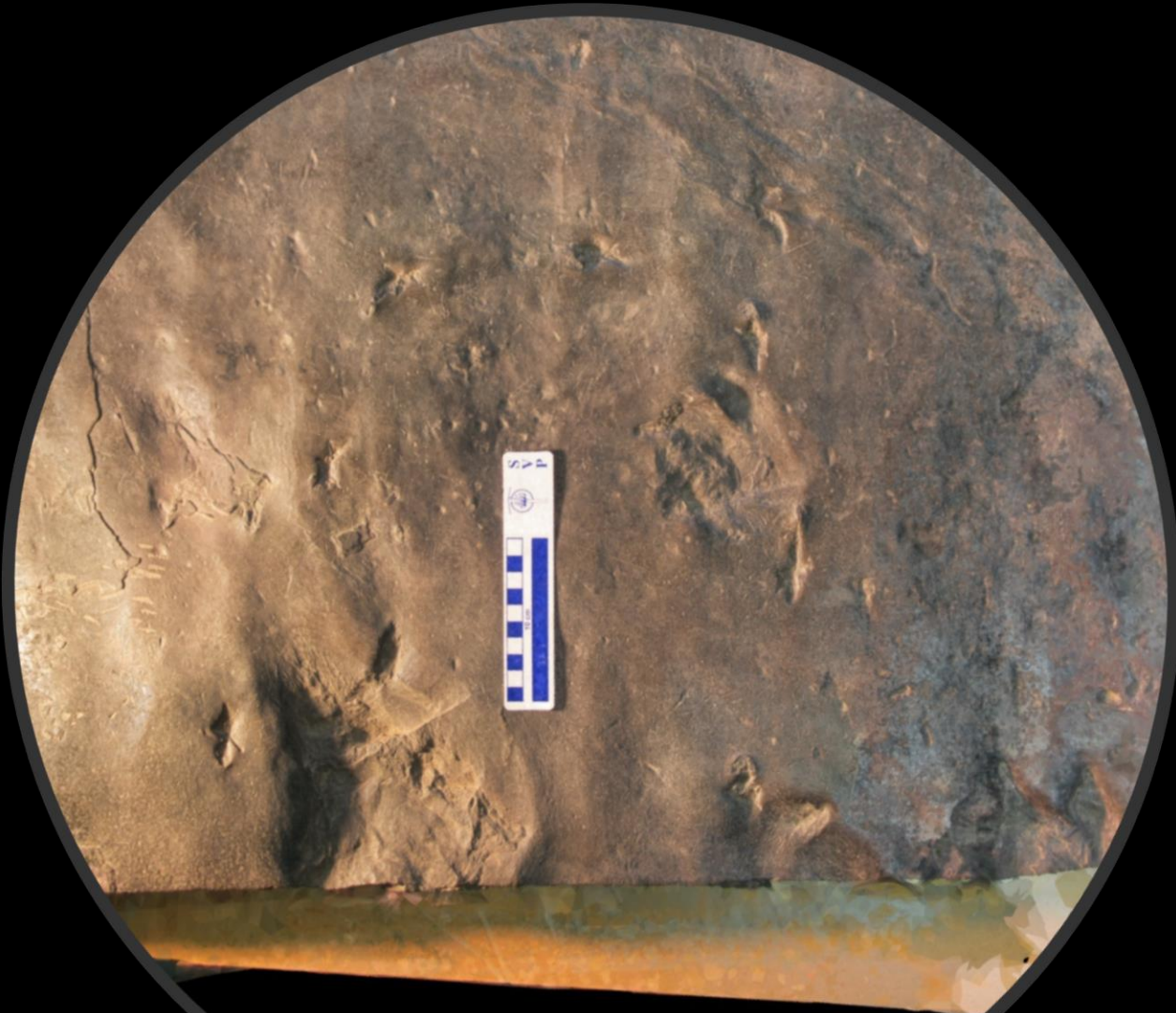
(NOT A  
PALAEOARTIST)

THEROPOD

BIRD



# Dinosaur-Bird Evolution



200 million year old dinosaur tracks

Bird tracks, last winter





Theropod track, Paluxy River, Tx. Falkingham et al 2018

# Comparison with Extant Taxa



# Comparison with Extant Taxa



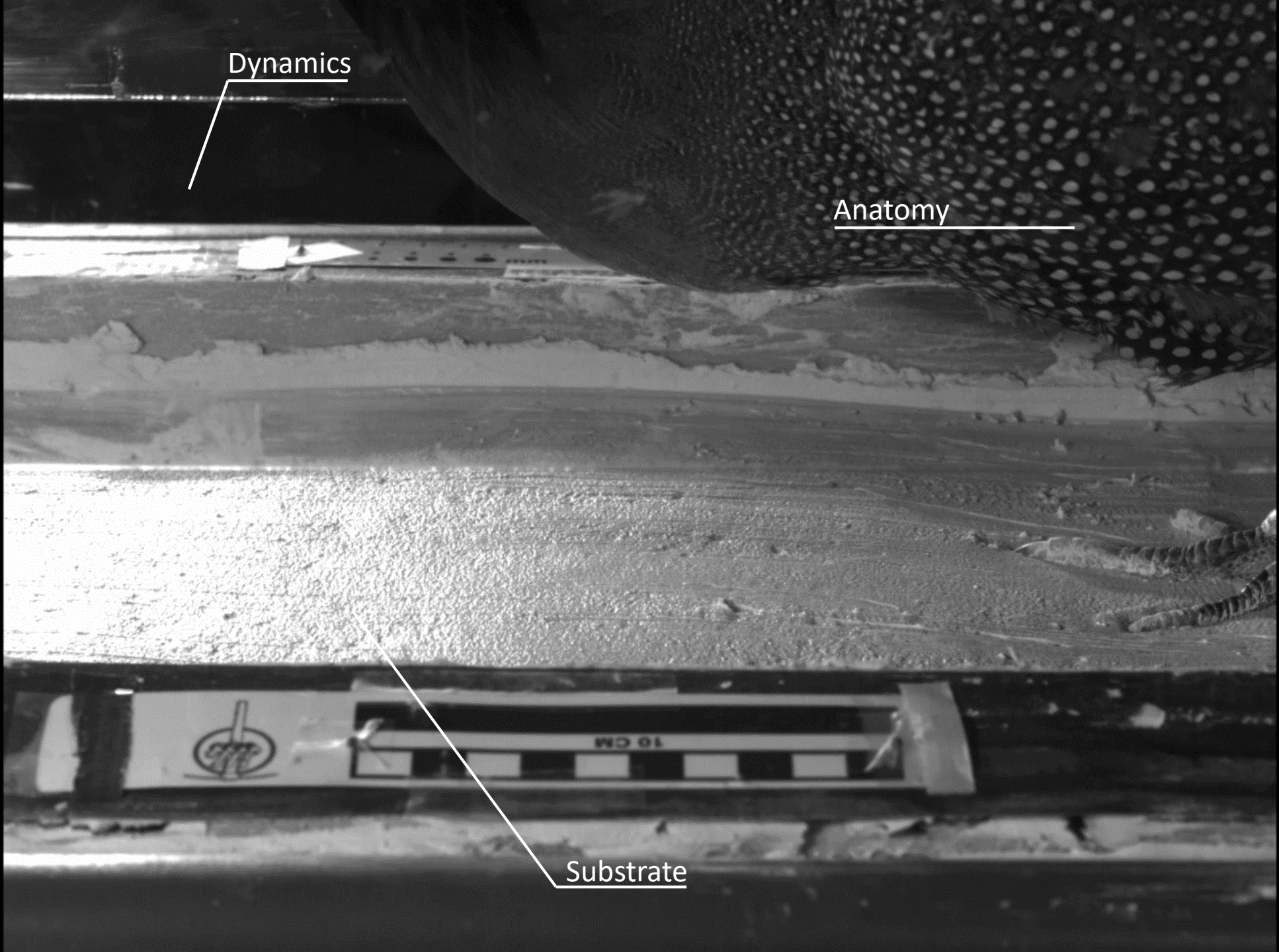
# Tracks from extant taxa



Dynamics

Anatomy

Substrate





Anatomy + Substrate + Dynamics  
=  
Track Morphology

# Fossil footprints

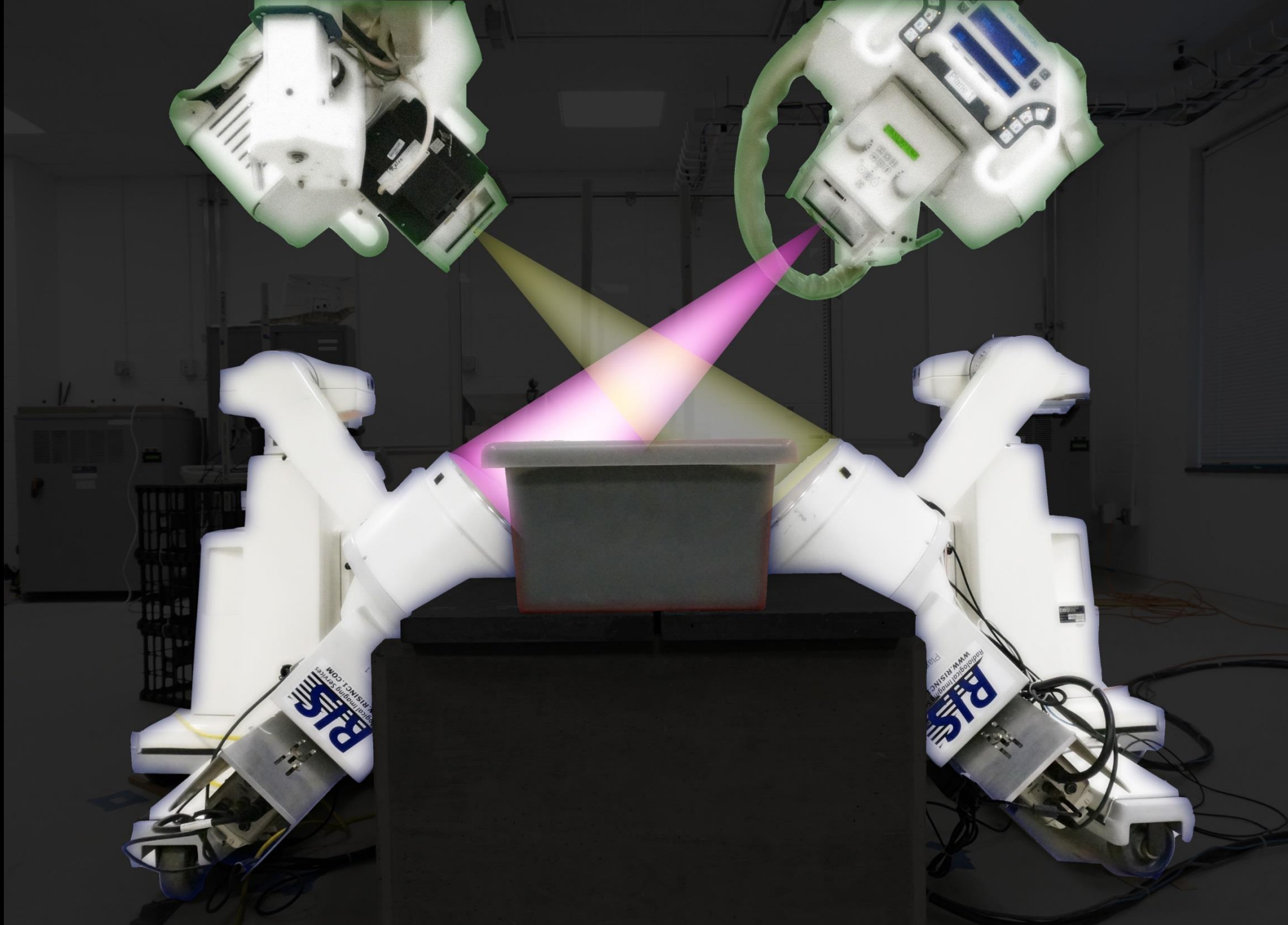
- Most studies for >150 years have focused on tracks that “look like feet”
- But deep, messy, tracks record more motion
- Opacity of substrate makes viewing the foot difficult

# XROMM

X-ray reconstruction of moving morphology

# Sediment trackway





1/10<sup>th</sup> Speed

X-ray

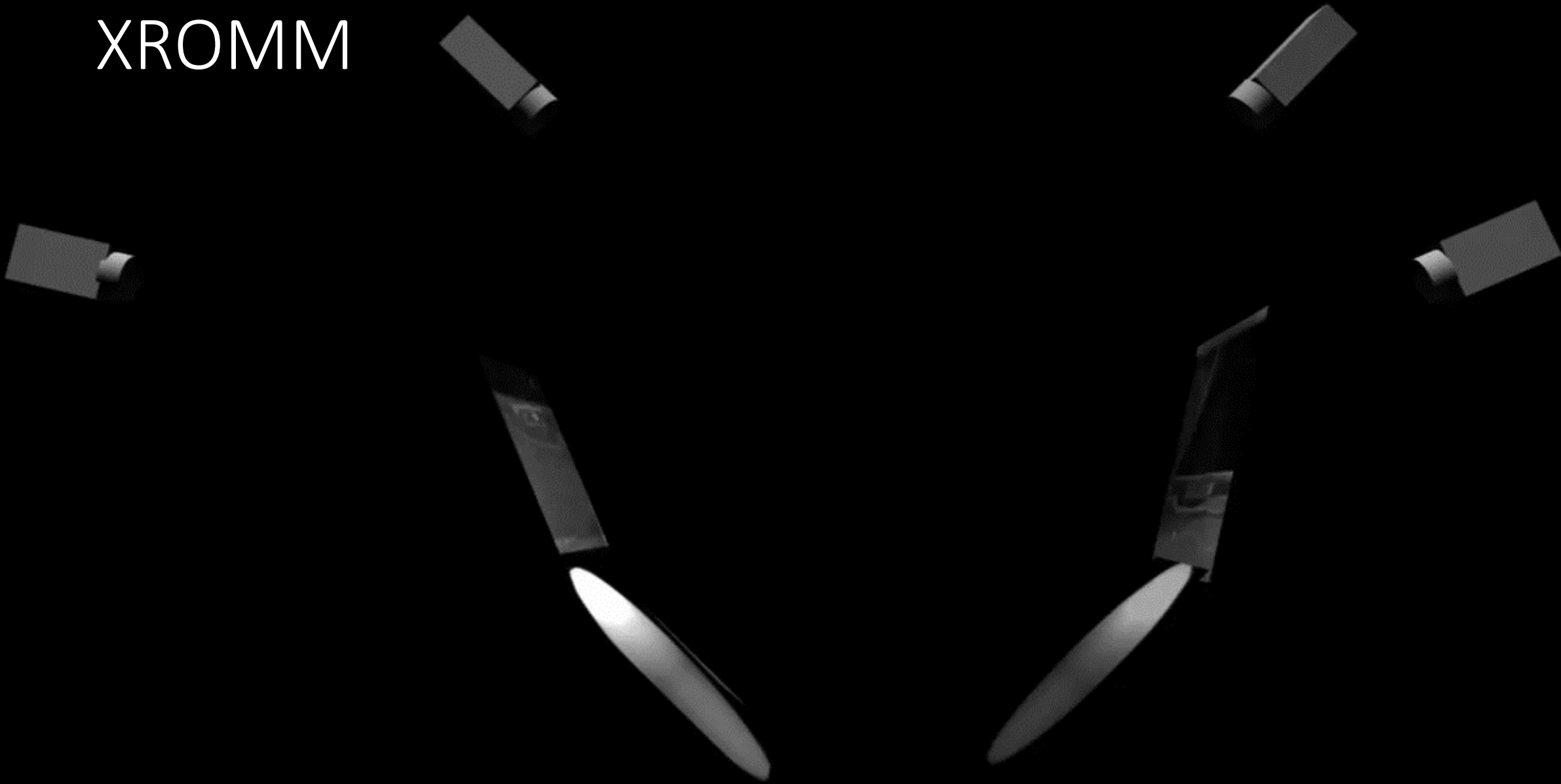


# CT Scan of the bird

- Reference Pose
- A starting position defined as objectively as possible

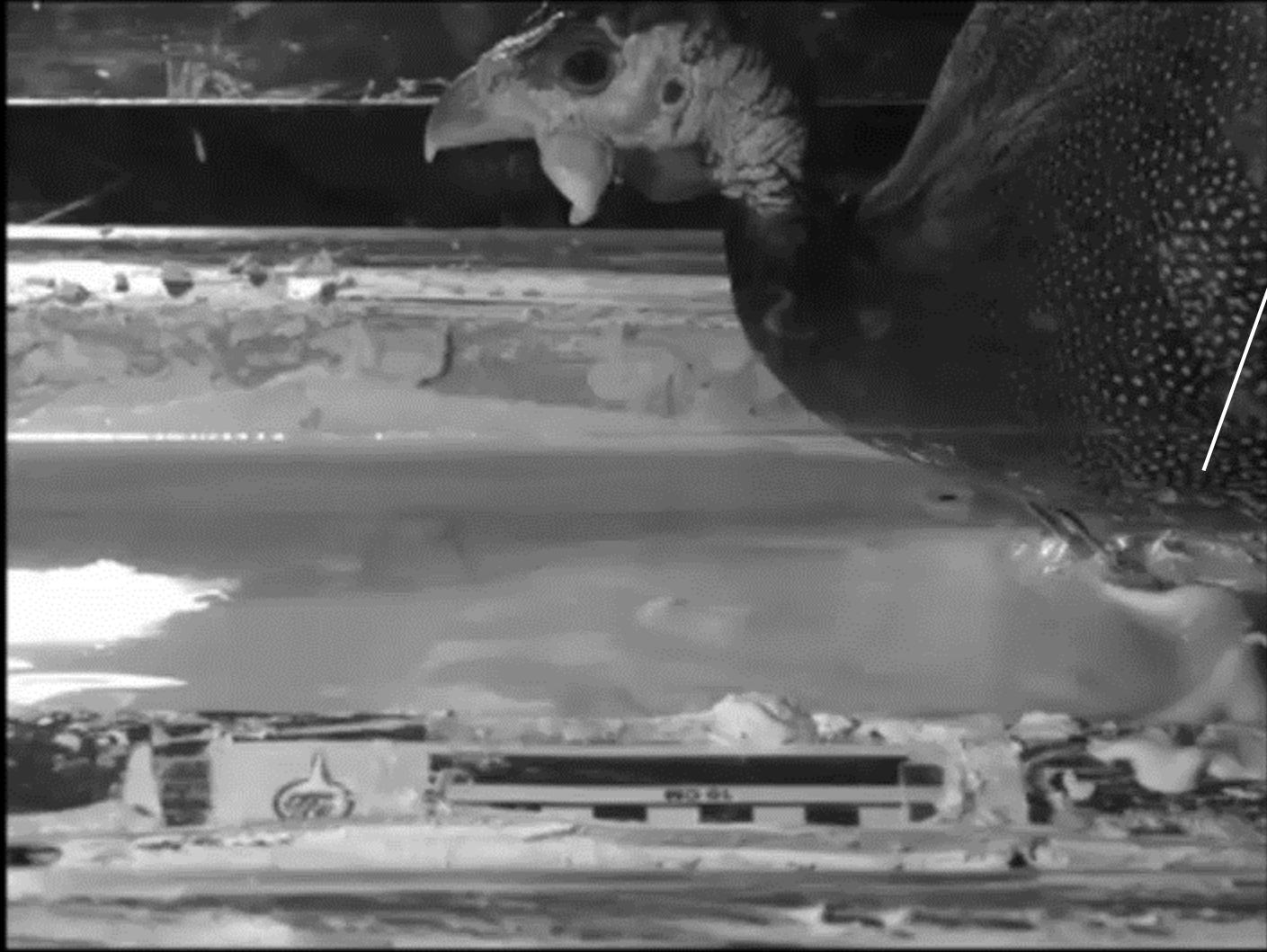


XROMM

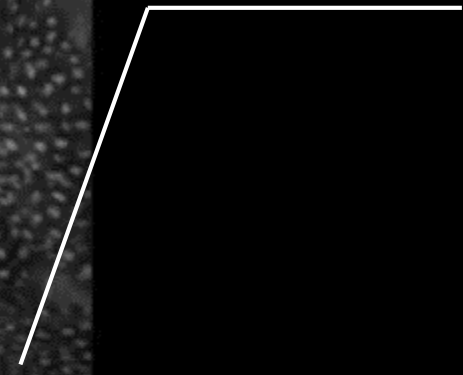




1/10 speed



Photogrammetric model  
of track surface



1/5 speed

XROMM data  
Falkingham and Gatesy 2014  
Gatesy and Falkingham 2017

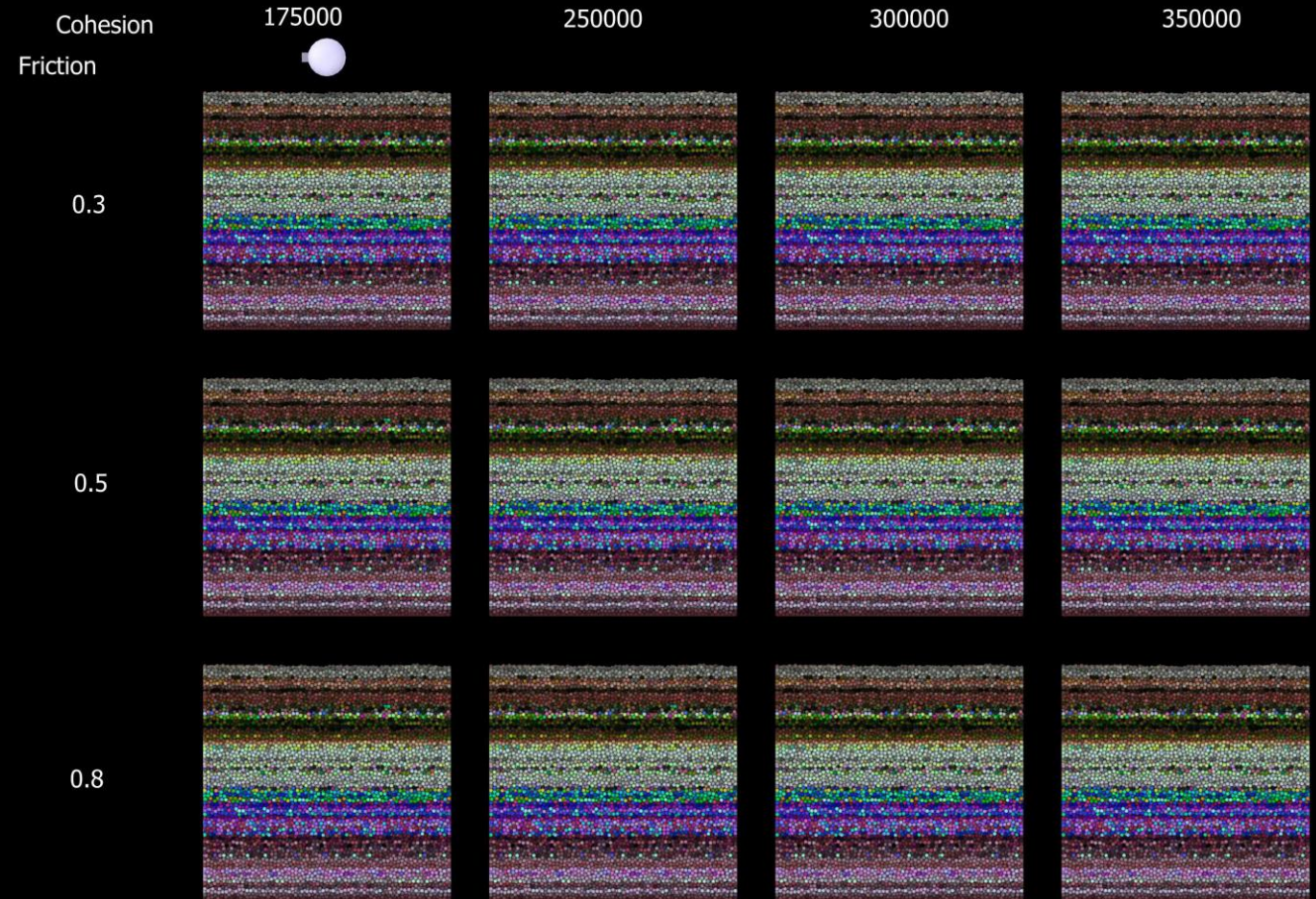
# Simulation

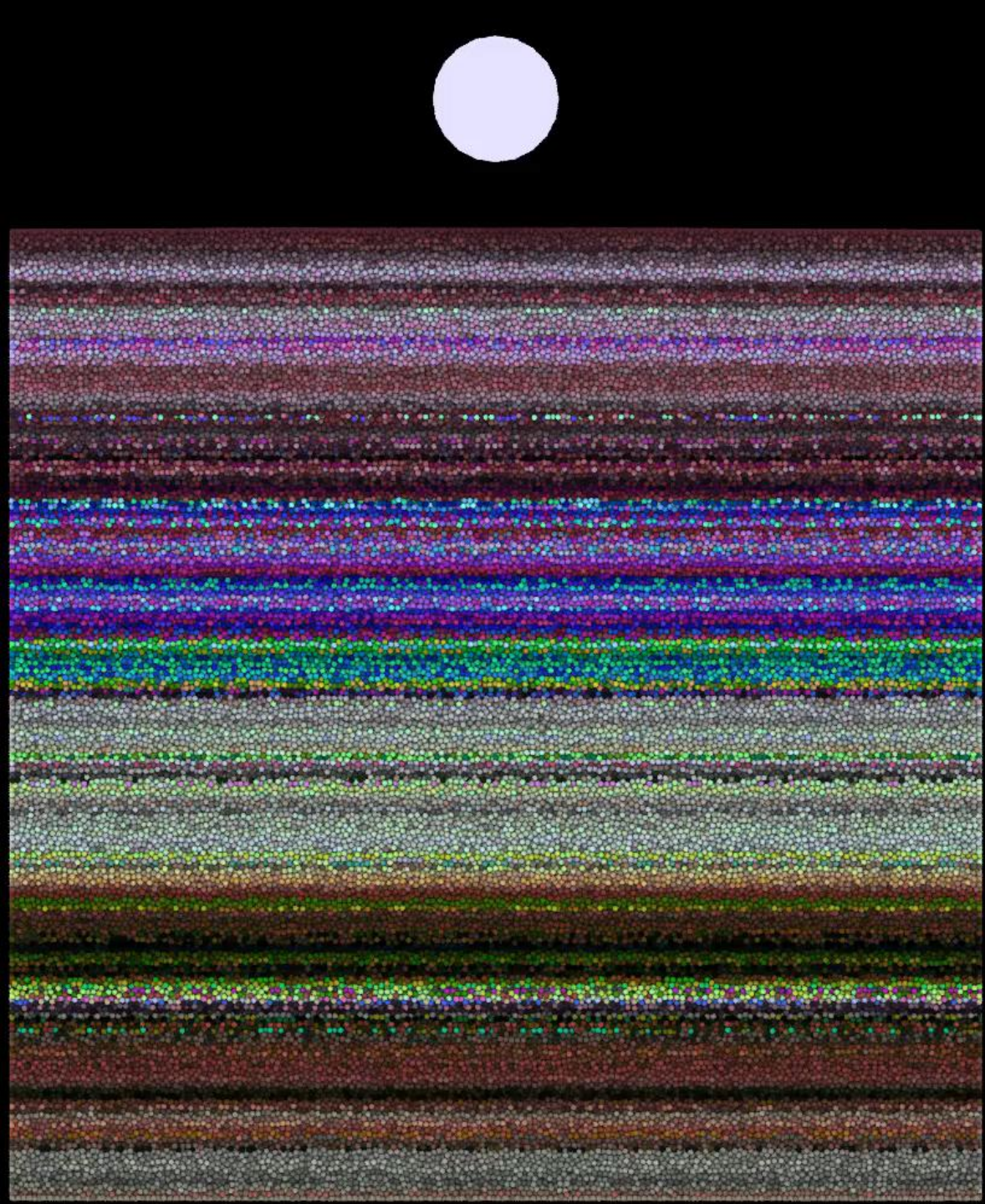
- LIGGGHTS ([www.cfdem.com](http://www.cfdem.com))



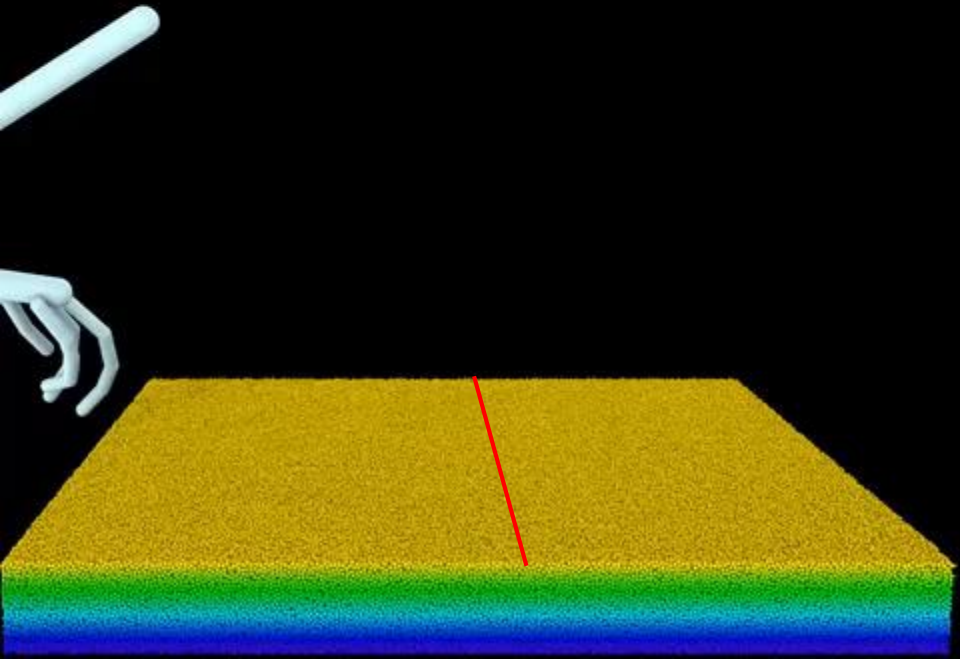
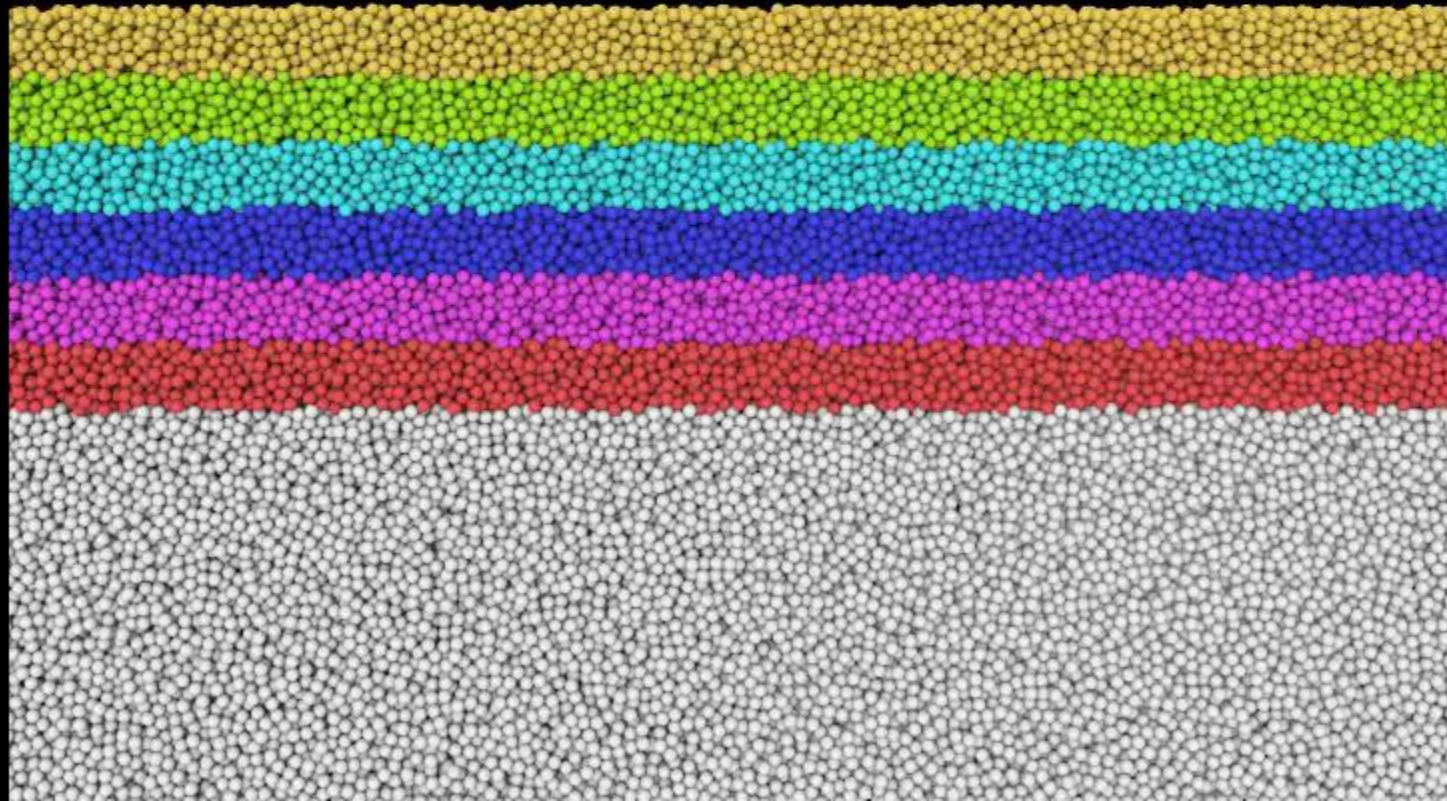
# Parameter searches

- Can change cohesion, friction etc.
- It's hard!





Penetrative tracks



Penetrative  
dinosaur tracks

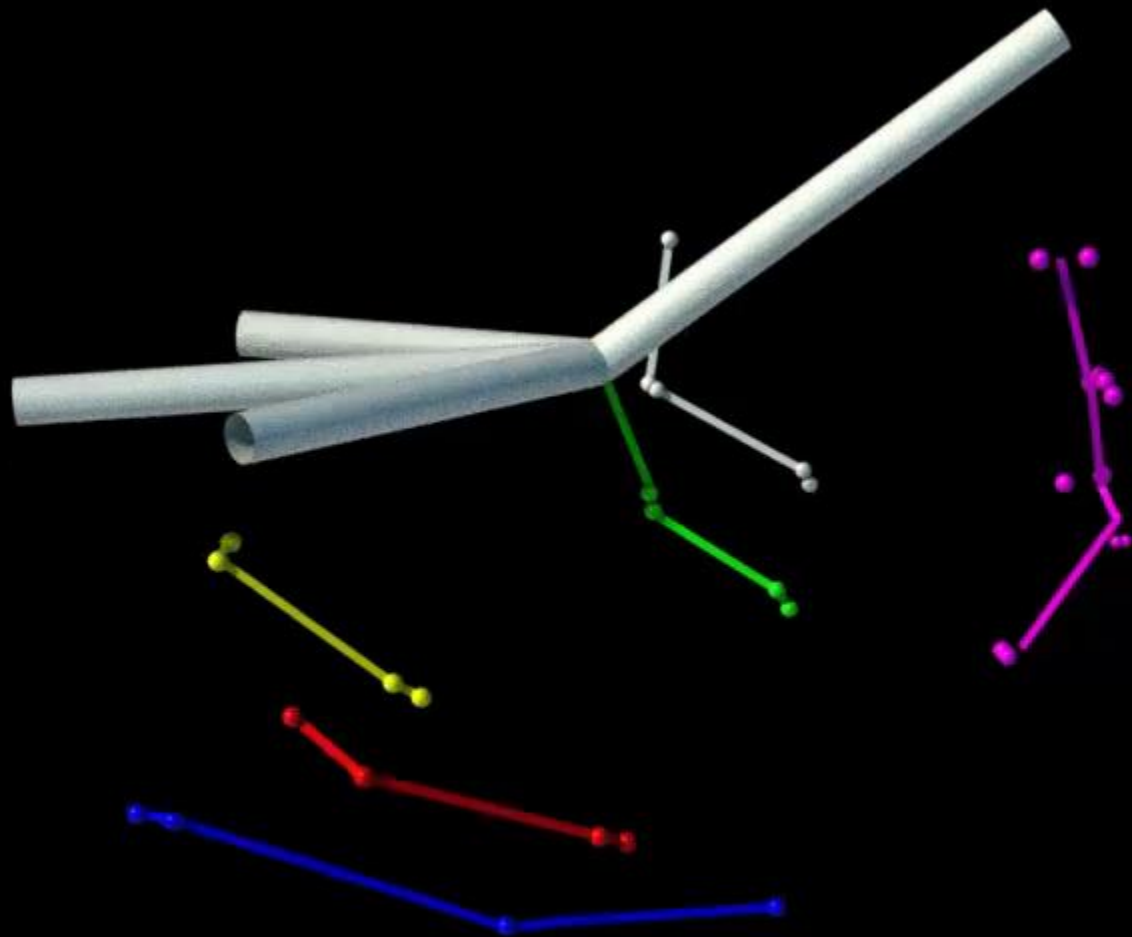


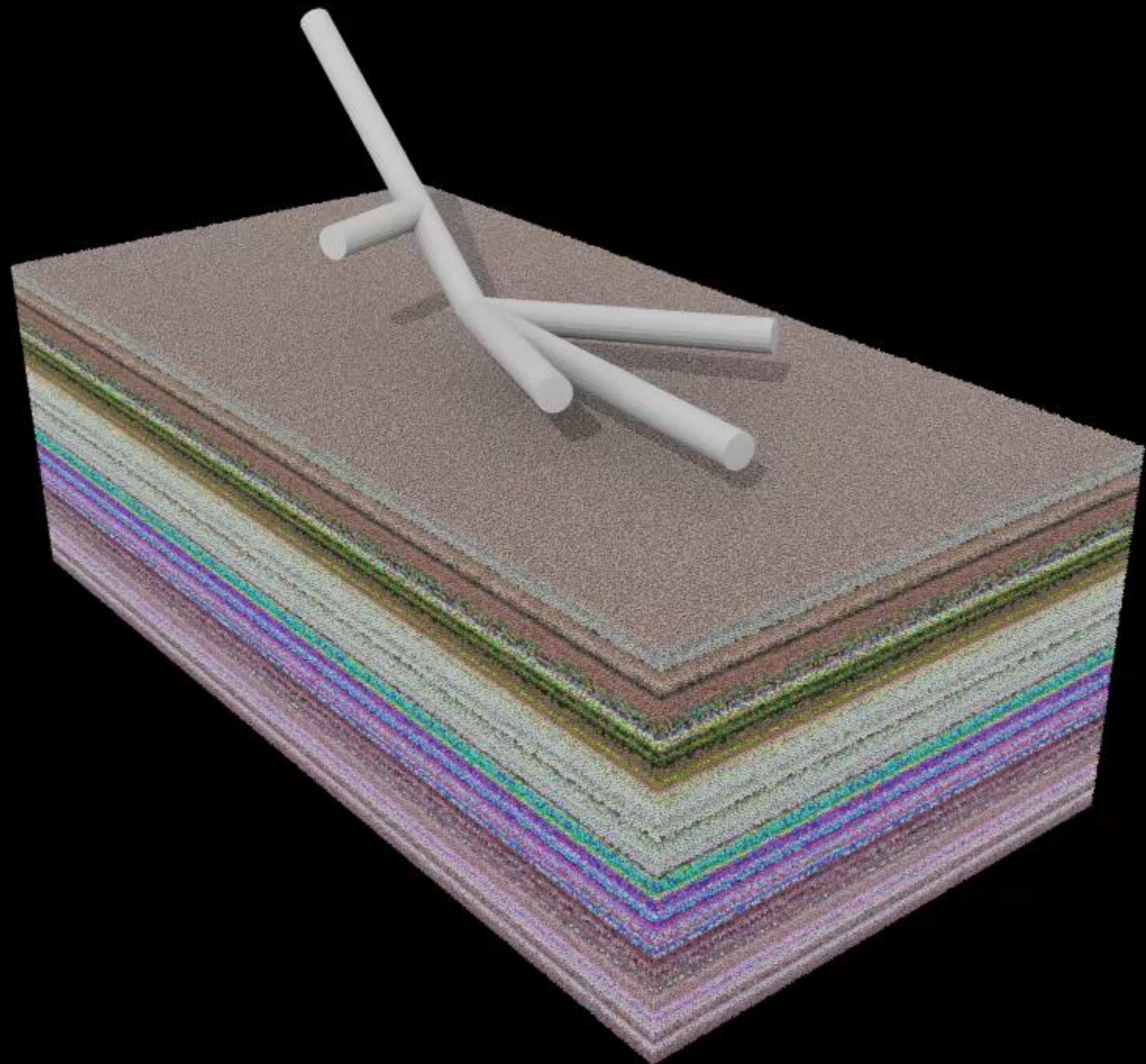
Penetrative  
dinosaur track











# Acknowledgements

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- Robert Kambic (Kennedy Krieger Inst.)

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