Understanding respiratory diseases using persistent homology

Francisco Belchí **(Kiko)**

Part of the EPSRC funded research group "*Joining the Dots*"

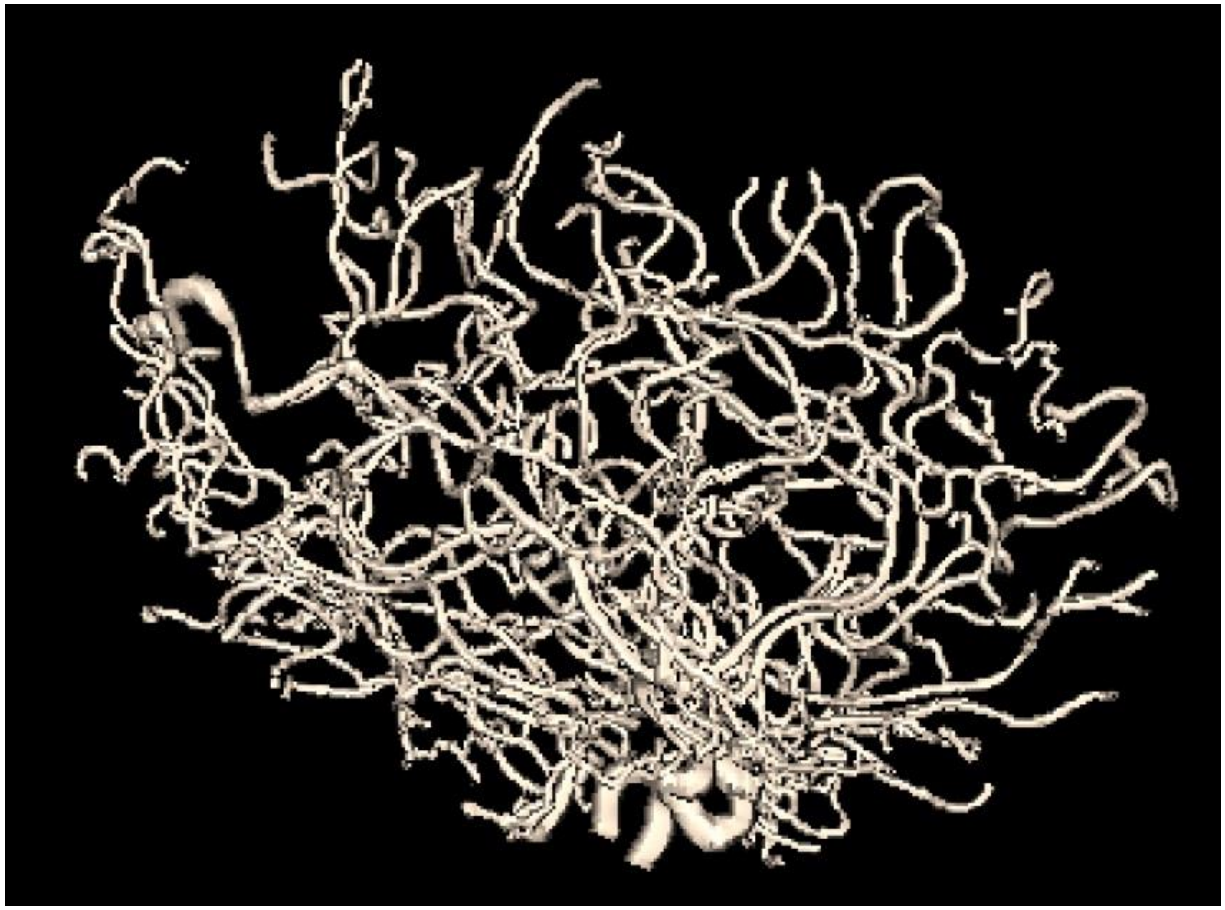
- UK research network in Applied Algebraic Topology &
***Joining the Dots* programme meeting -**

UNIVERSITY OF Southampton

Joining the Dots

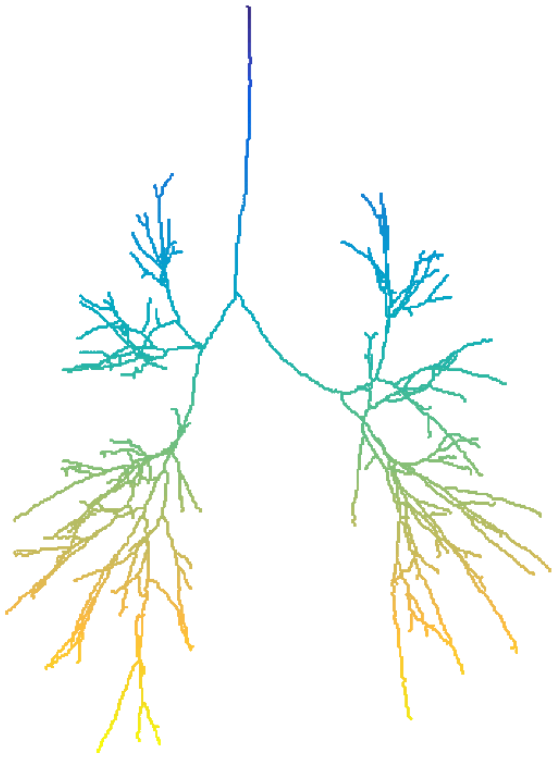
Brain artery trees

[Bendich et al., 2015]

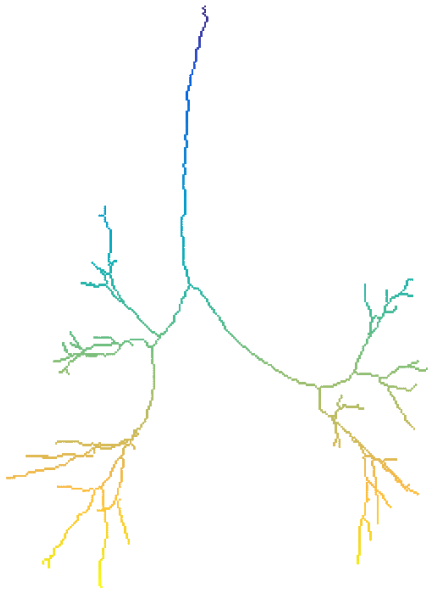


Bronchial trees

Inspiratory



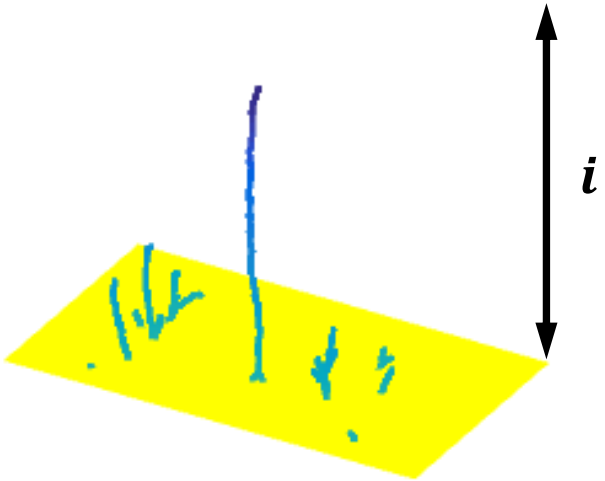
Expiratory

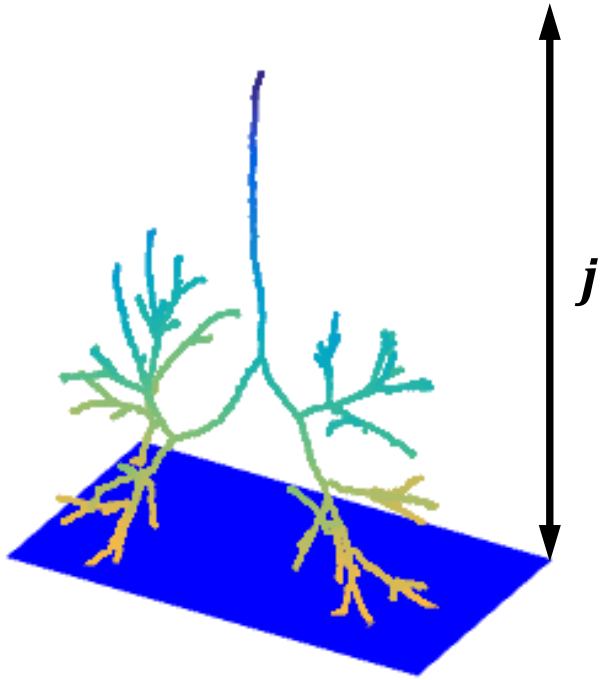


Persistent homology

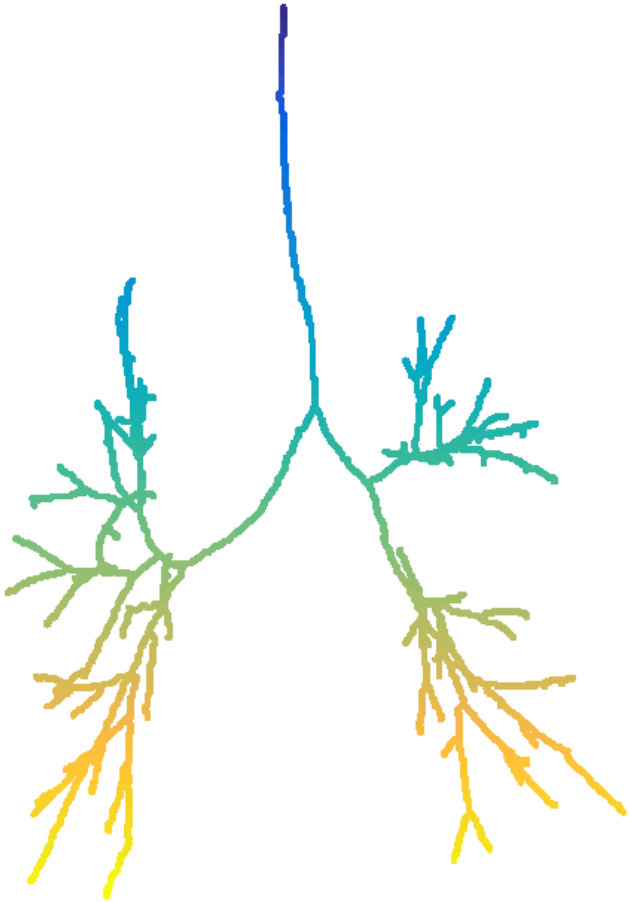
Evolution of H_n w.r.t. ...

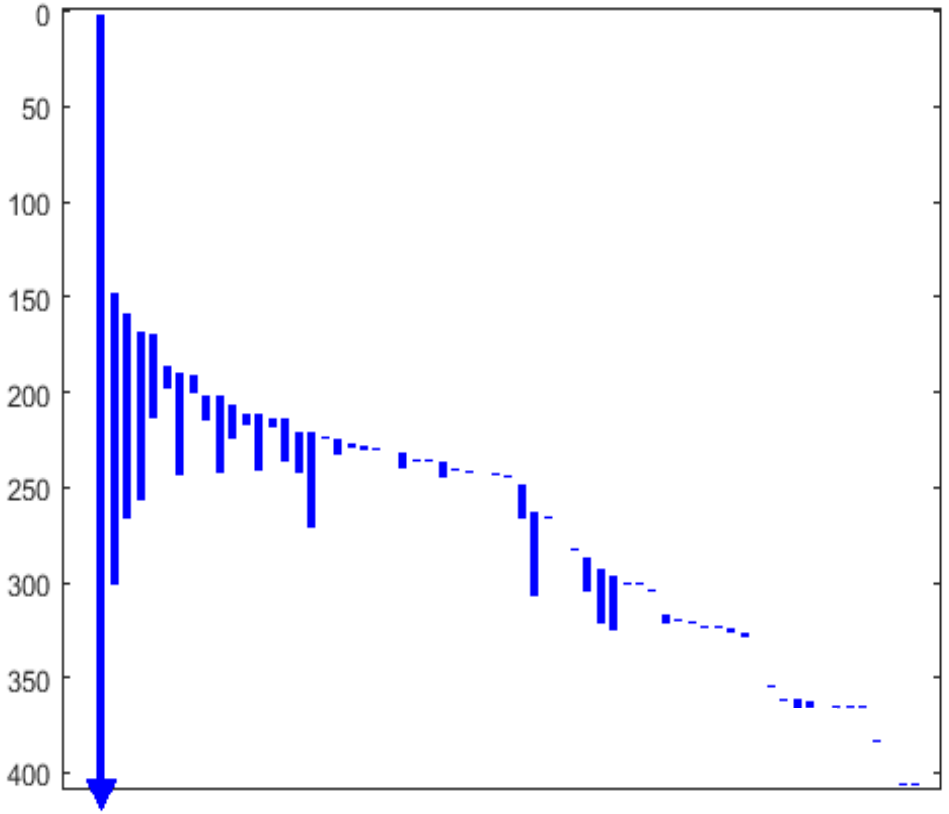
Evolution of H_0 w.r.t. height



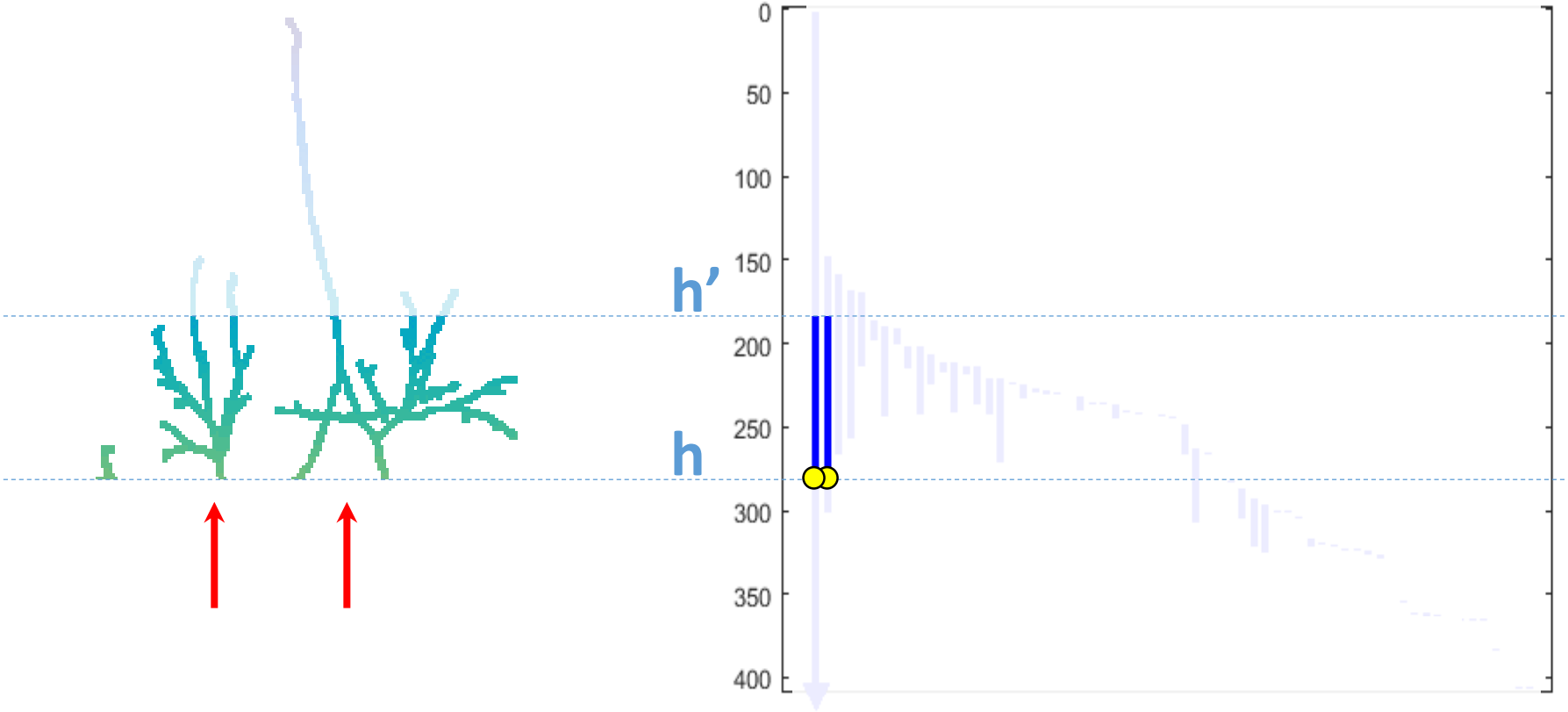


Evolution of H_0 w.r.t. height

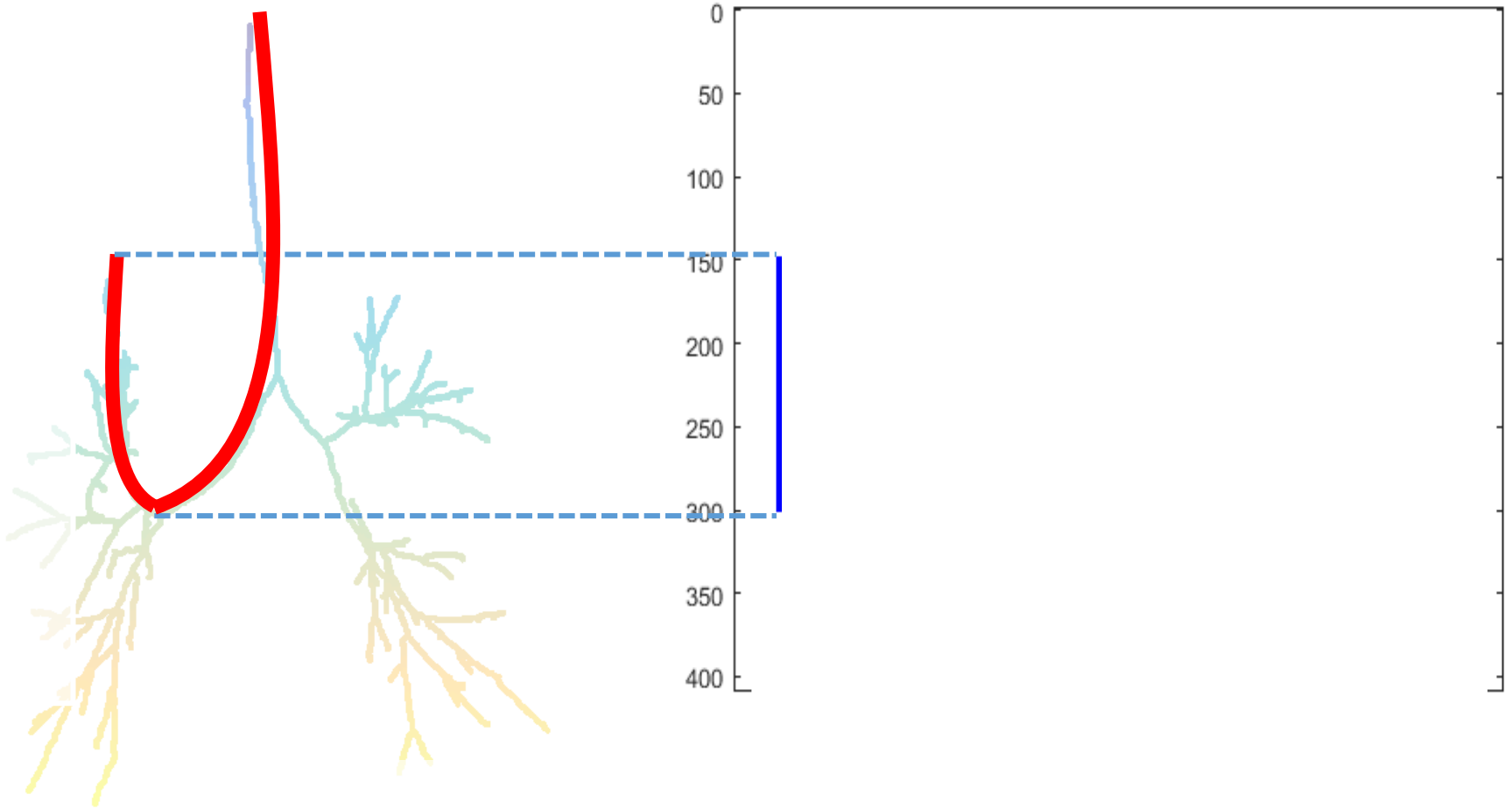




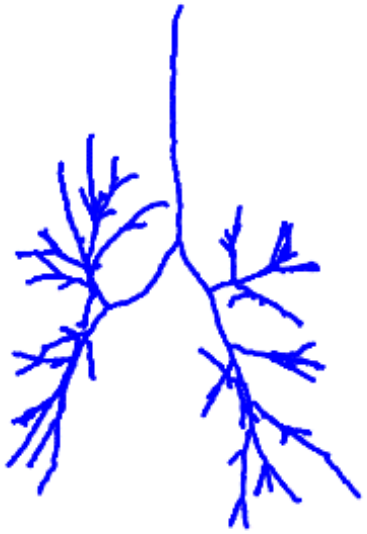
Algebraic/Topological Meaning



Geometric Meaning

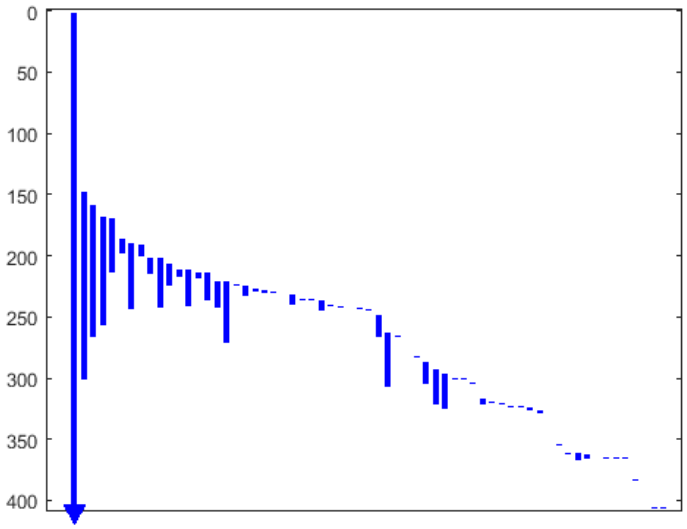


Similarity

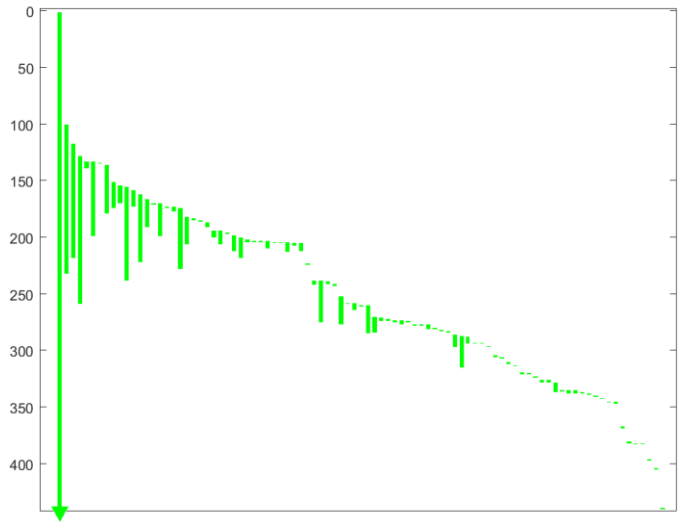


vs

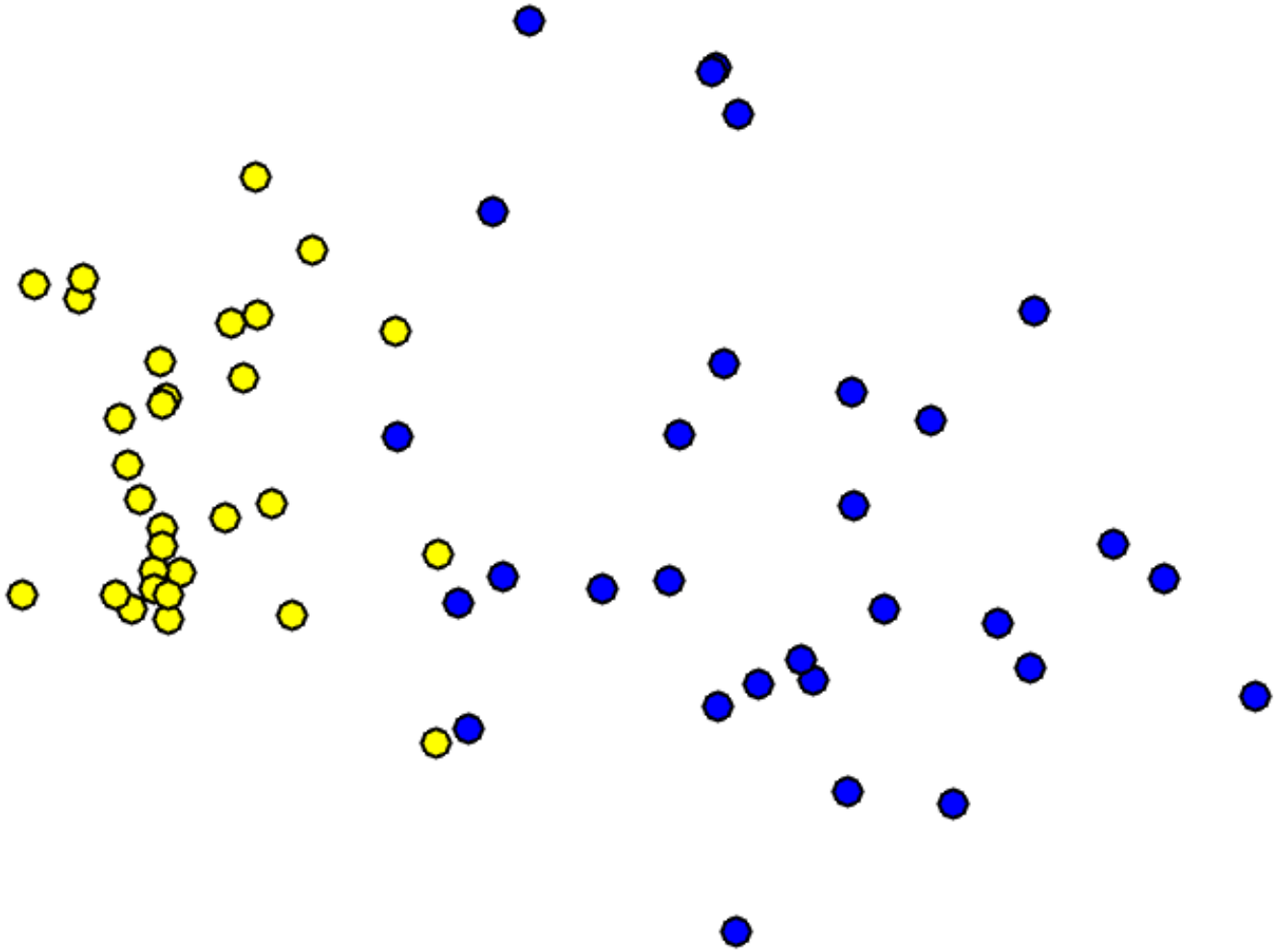
Similarity



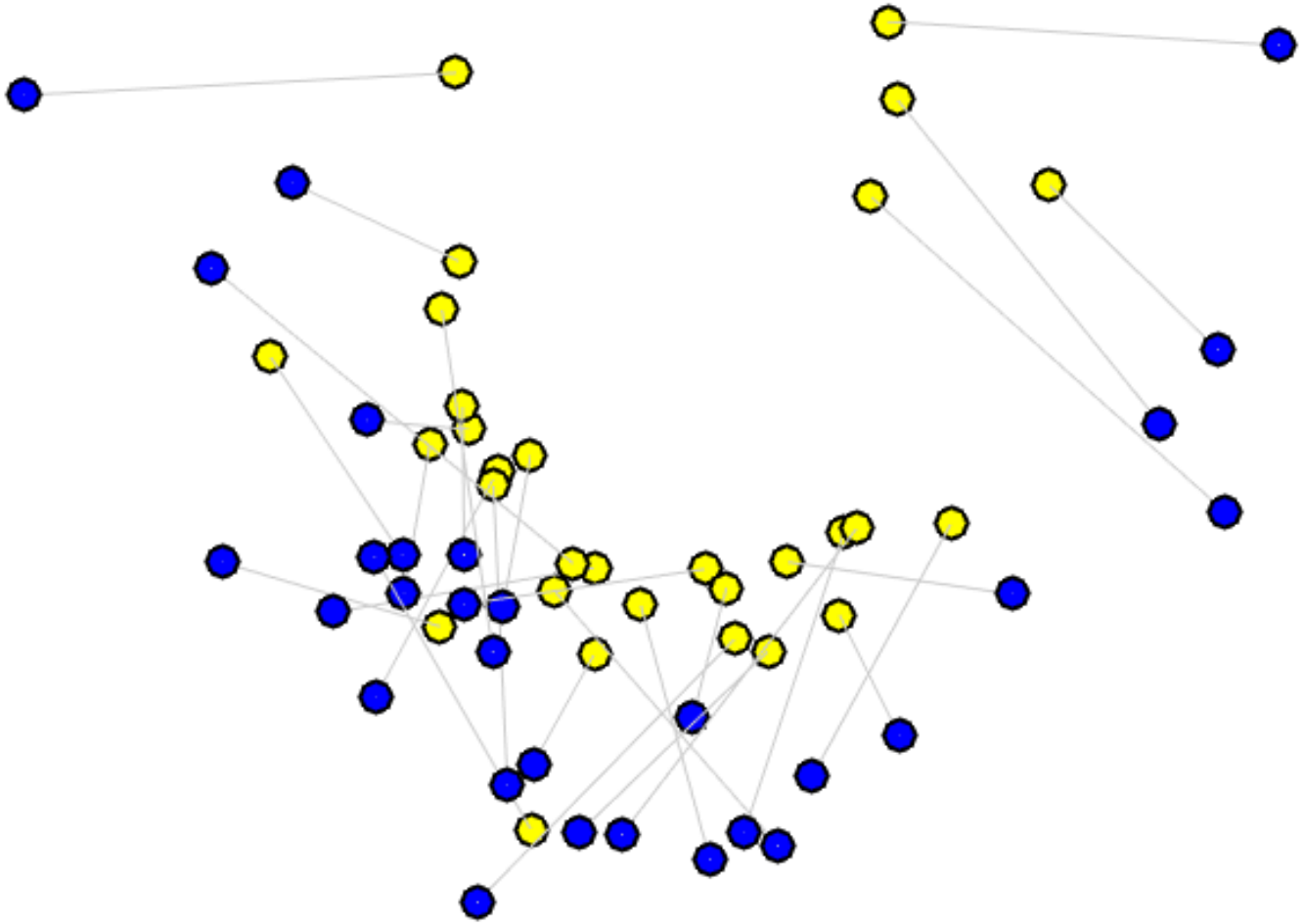
vs



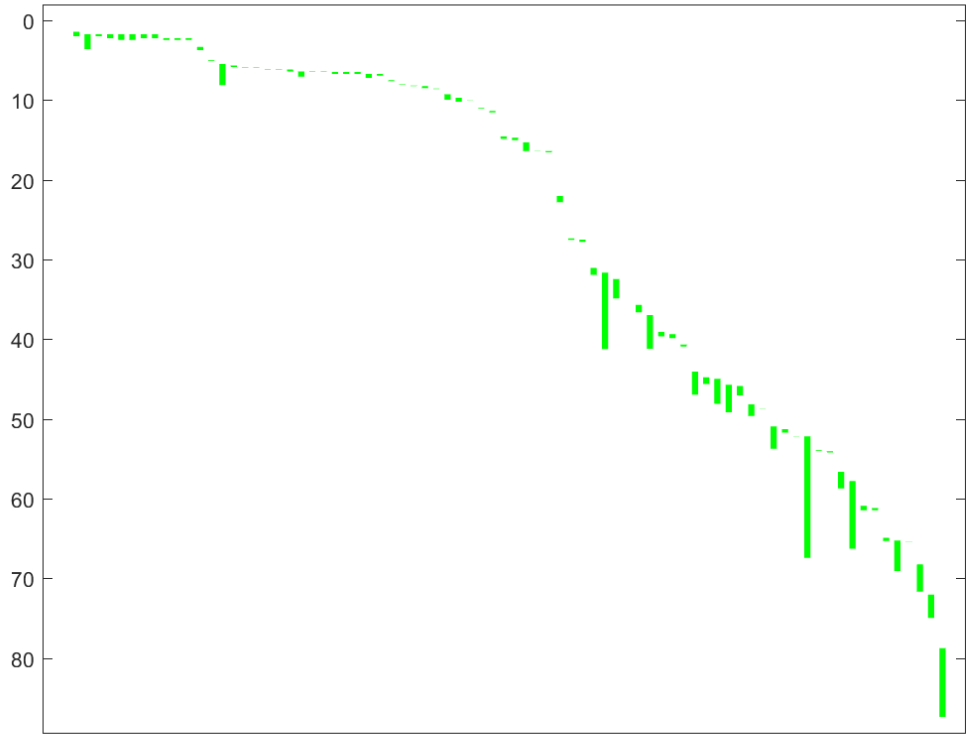
The Space of Lungs



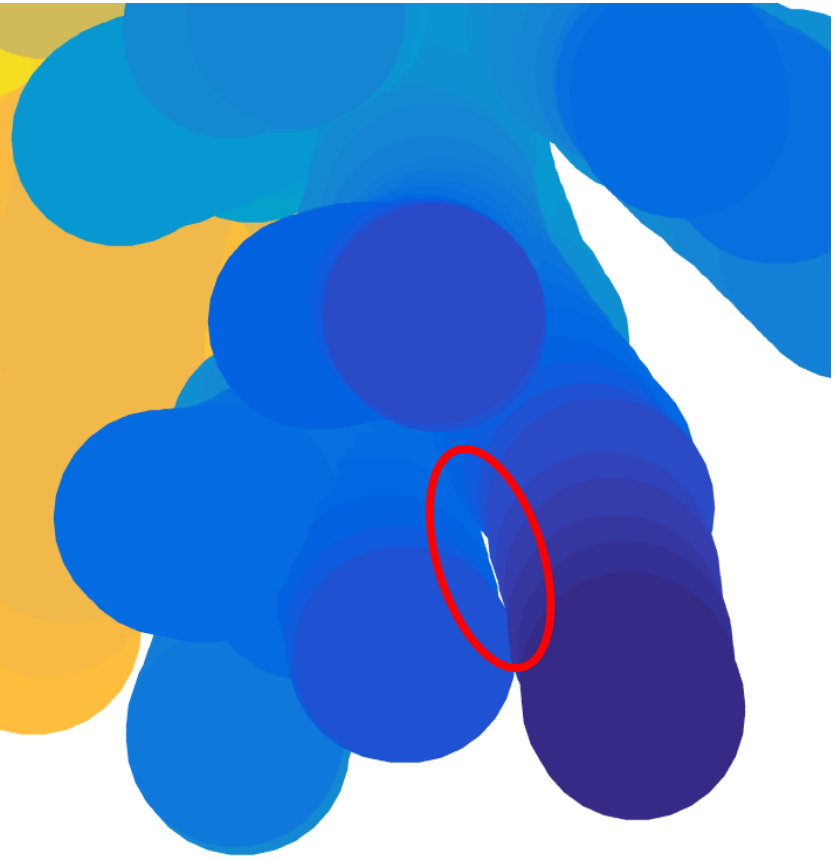
The Space of Lungs

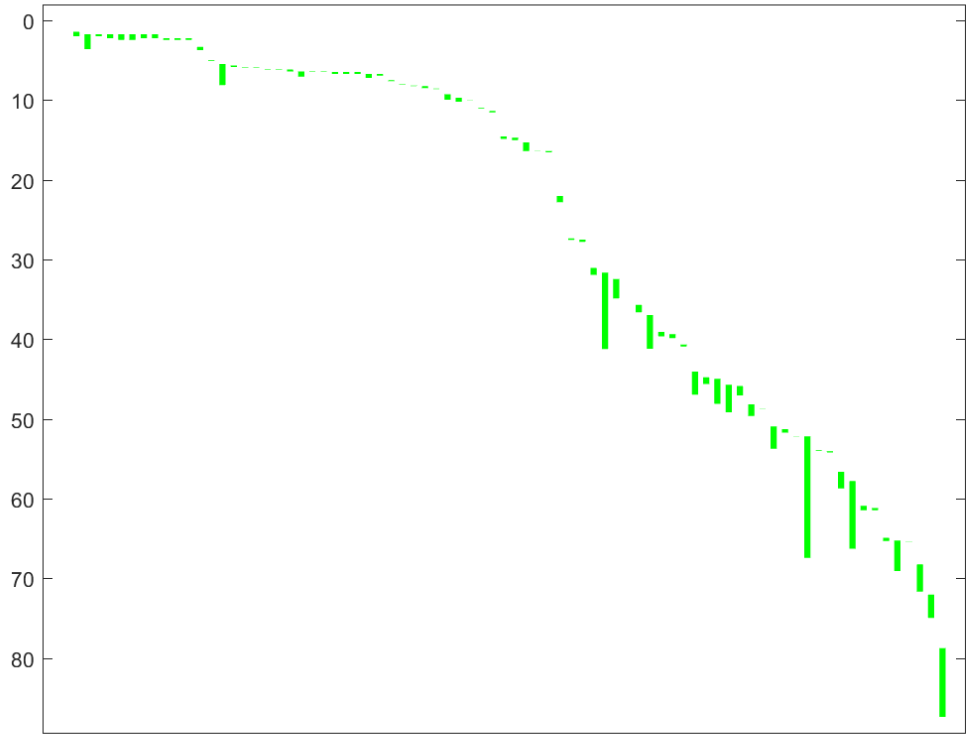


Evolution of H_1 w.r.t. thickness

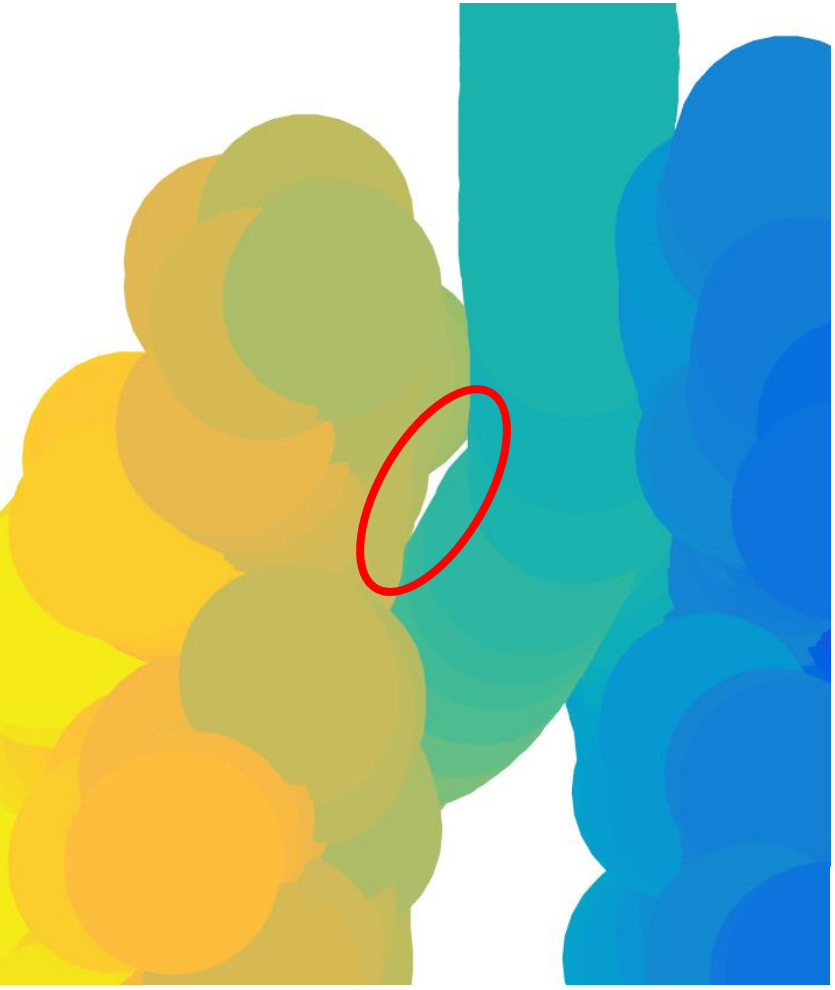


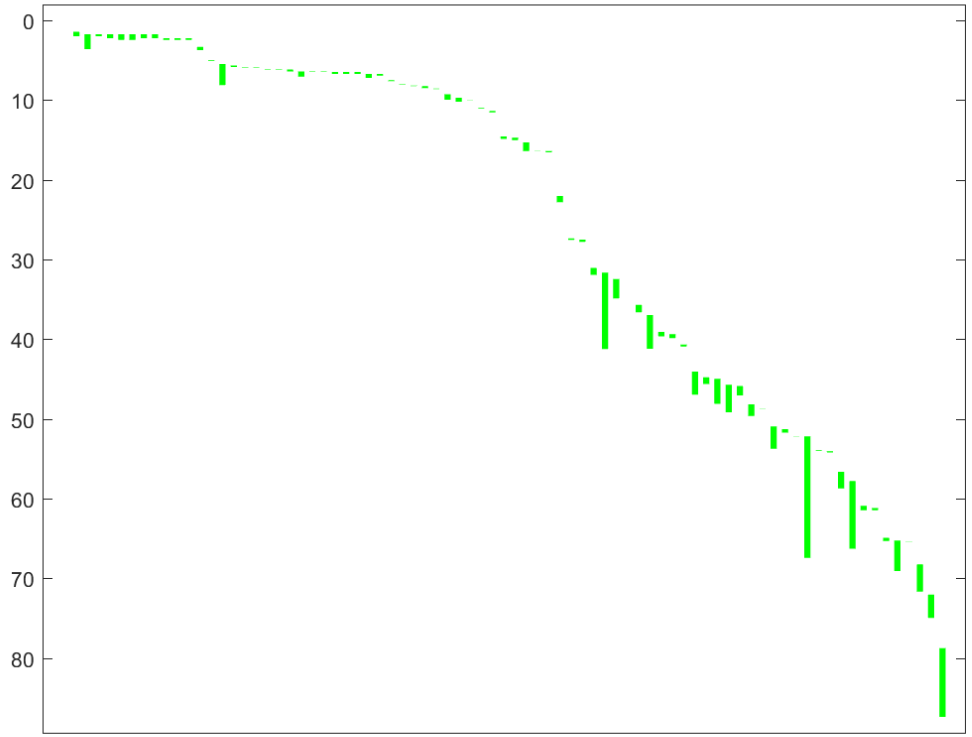
Evolution of H_1 w.r.t. thickness



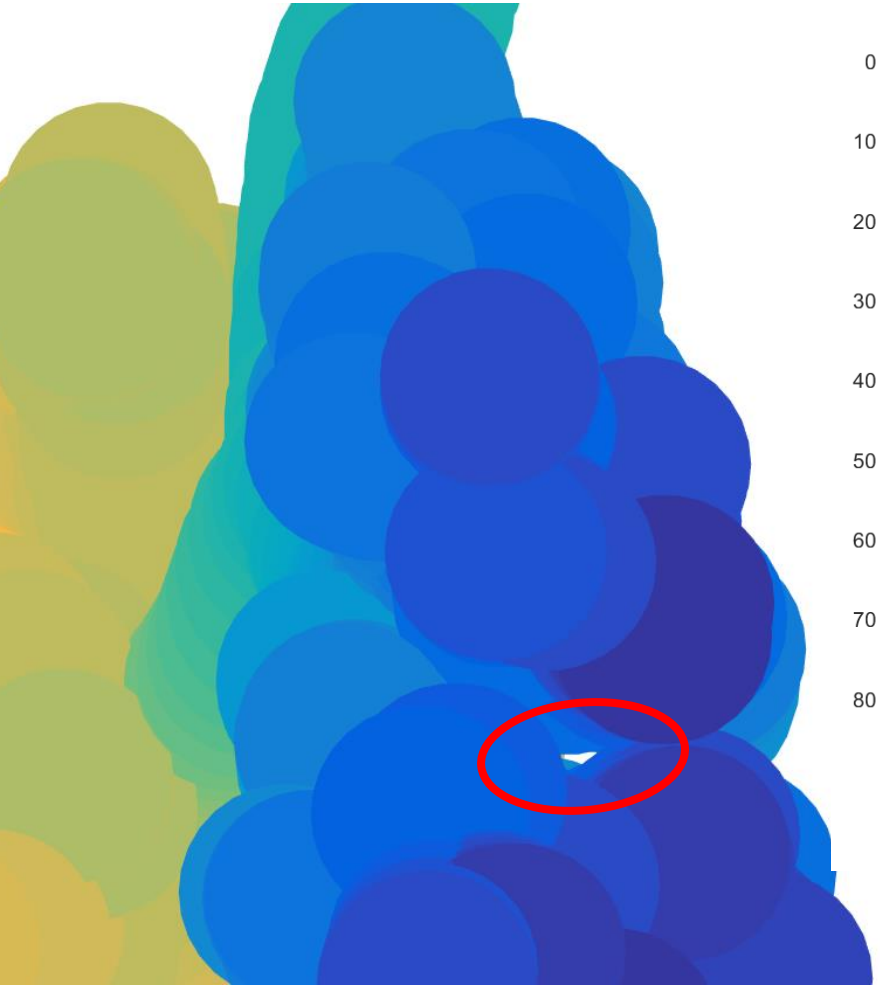


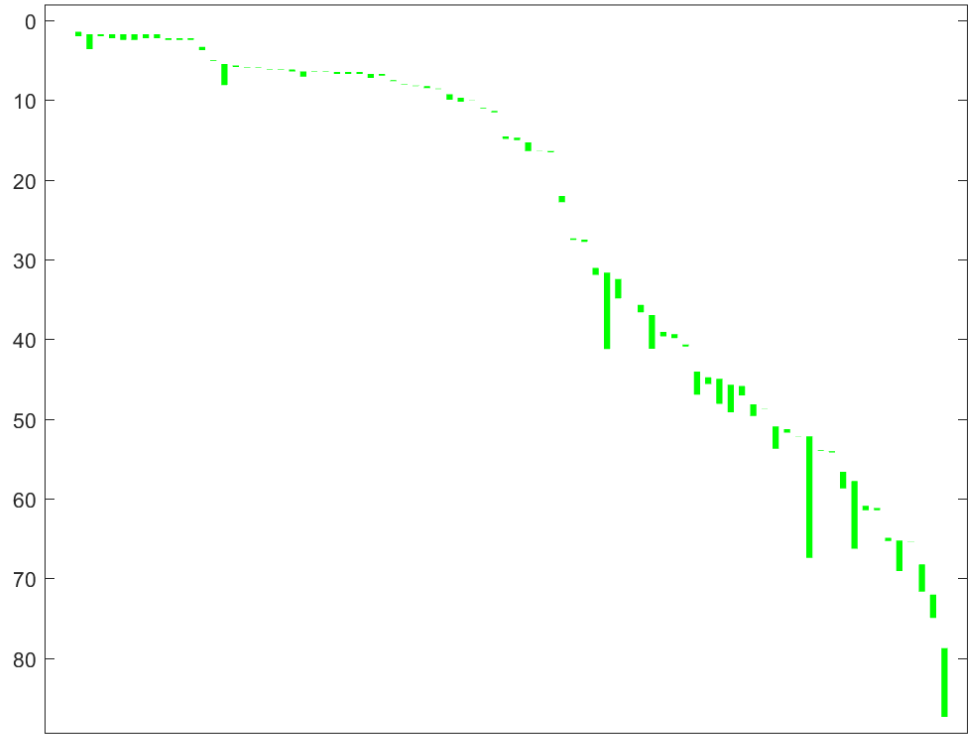
Evolution of H_1 w.r.t. thickness



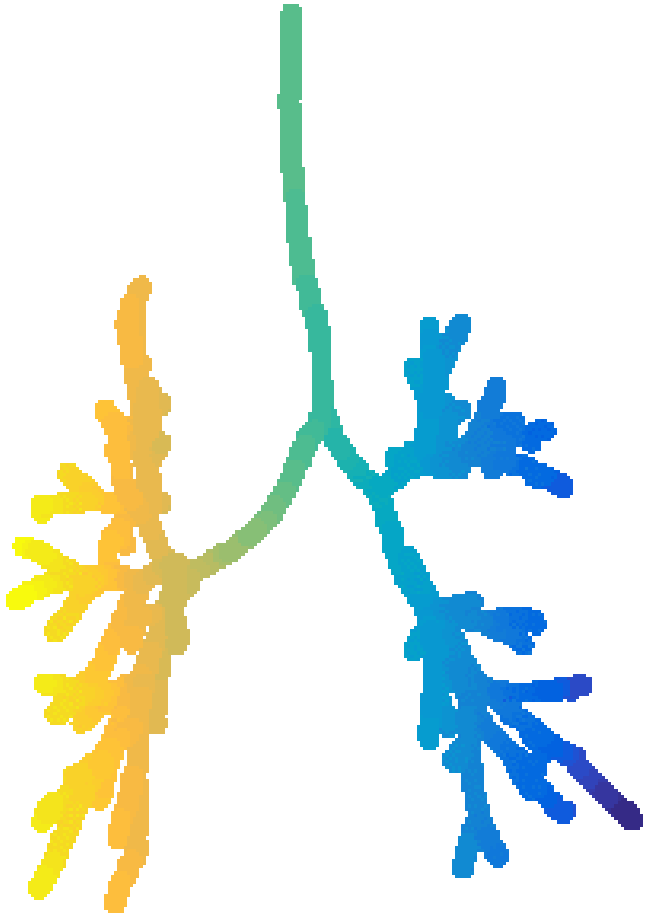


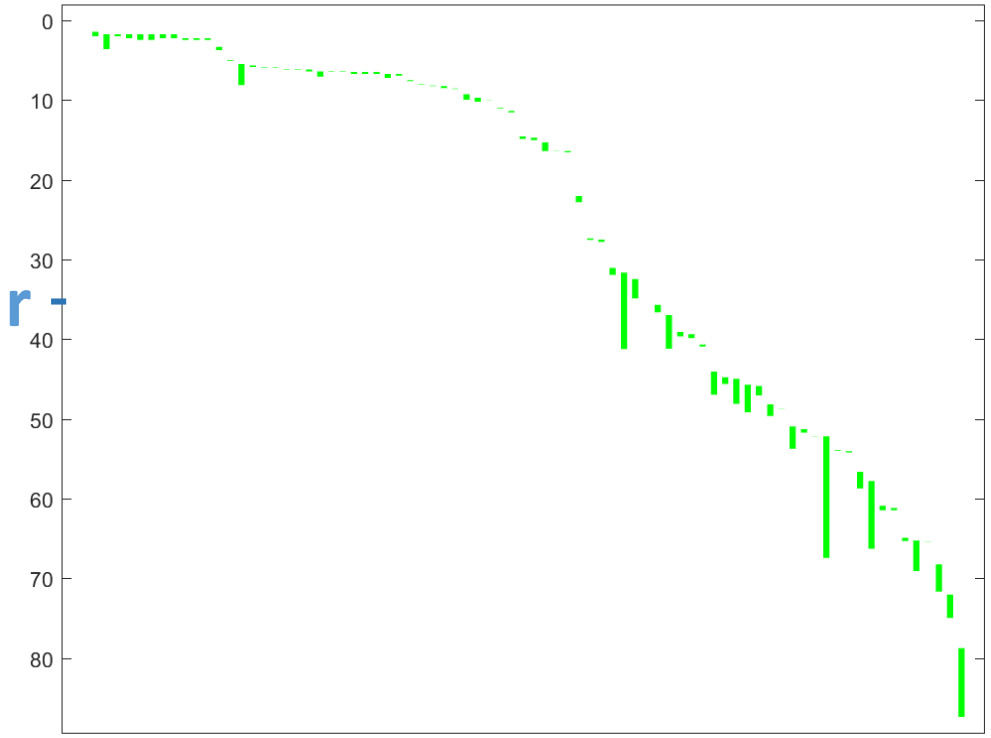
Evolution of H_1 w.r.t. thickness





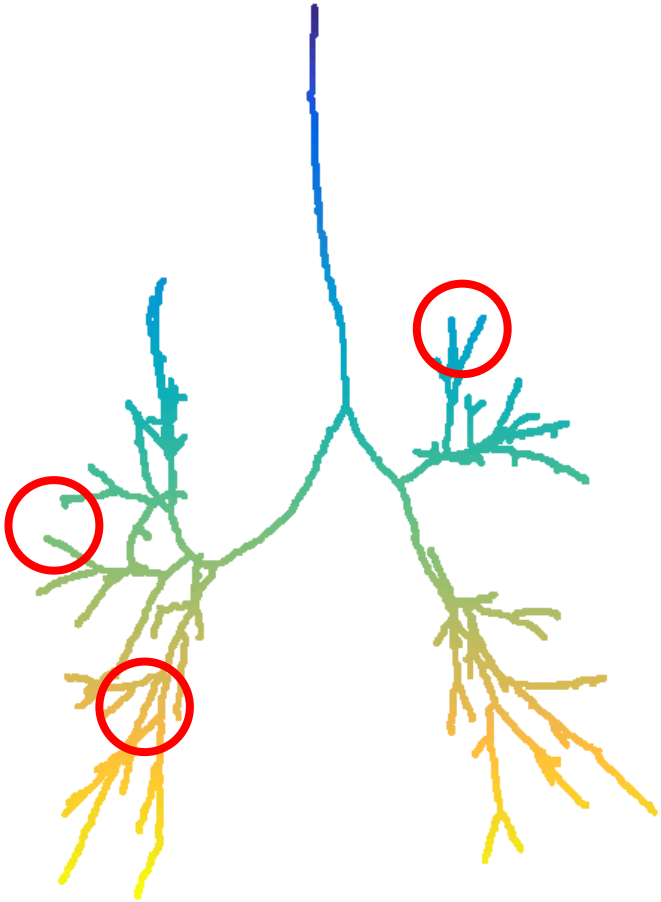
Algebraic/Topological Meaning

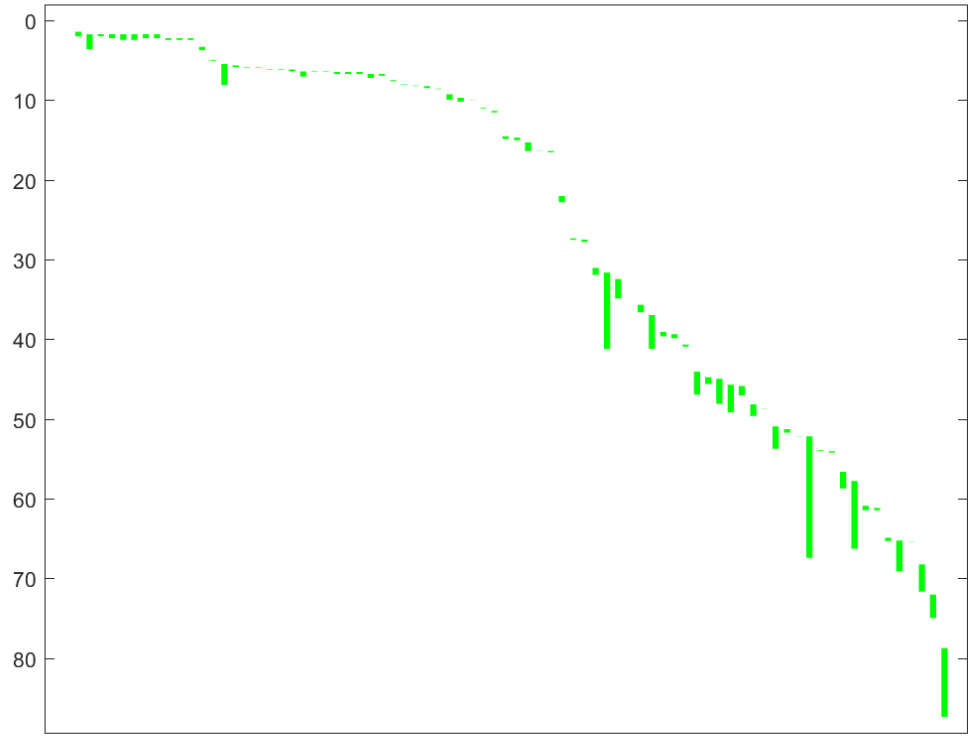




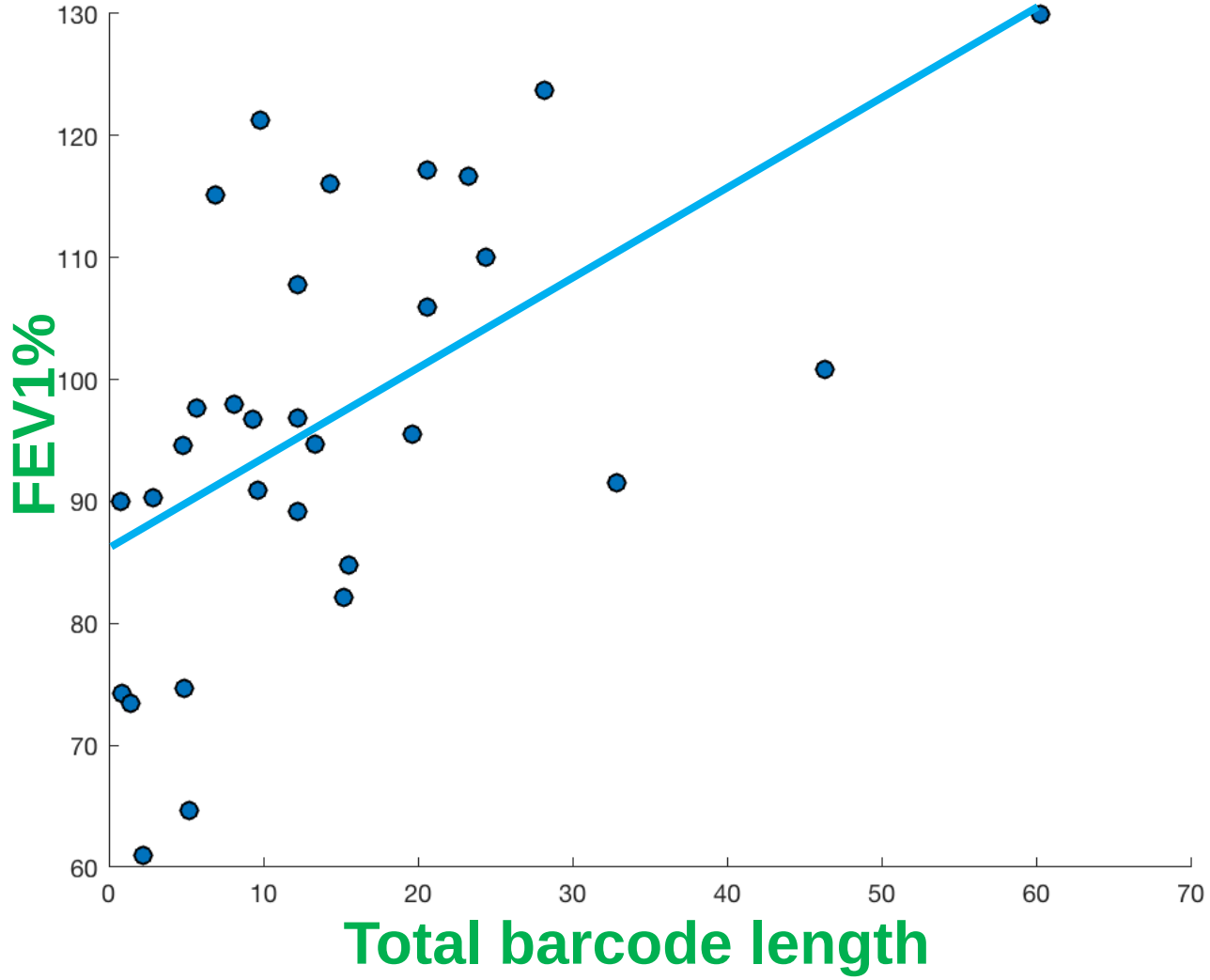
Algebraic/Topological Meaning

Geometric Meaning





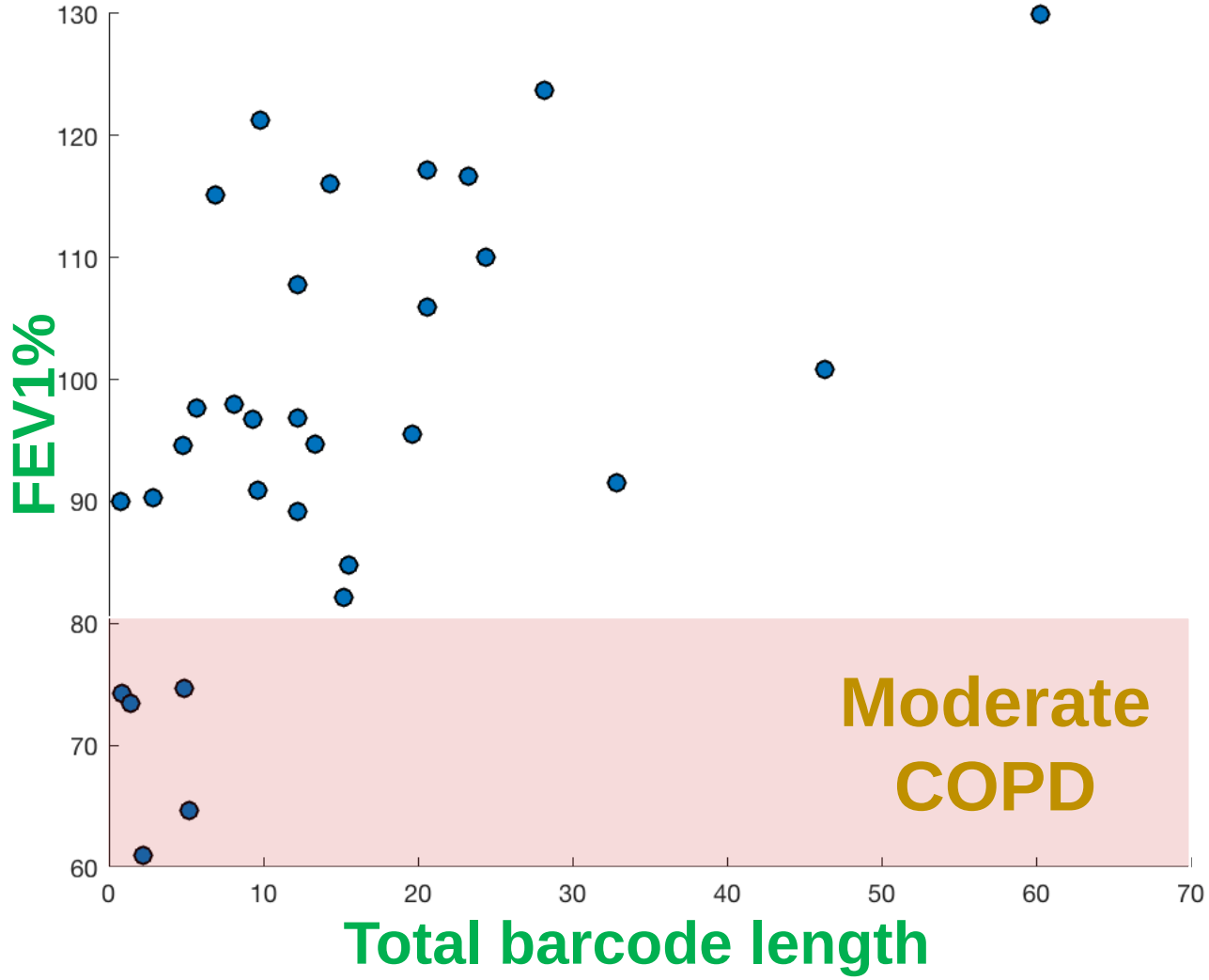
Barcode statistics



Pearson
$\rho = 0.57$
pVal $= 0.001$

$R^2 = 0.33$

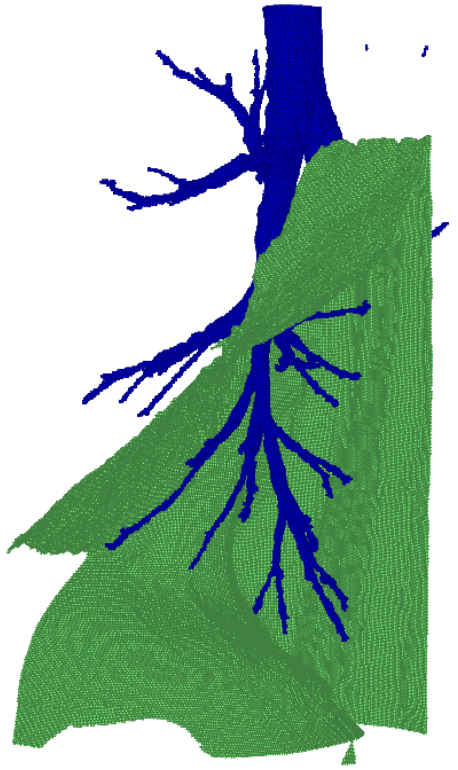
Barcode statistics



Local lung function

Further work

- H_2
- Breathing sounds
- More data



A work of the EPSRC funded research group
"Joining the Dots"