In Vivo X-Ray Imaging in Biomechanics and Developmental Biology

Beth Brainerd
University of Massachusetts Amherst

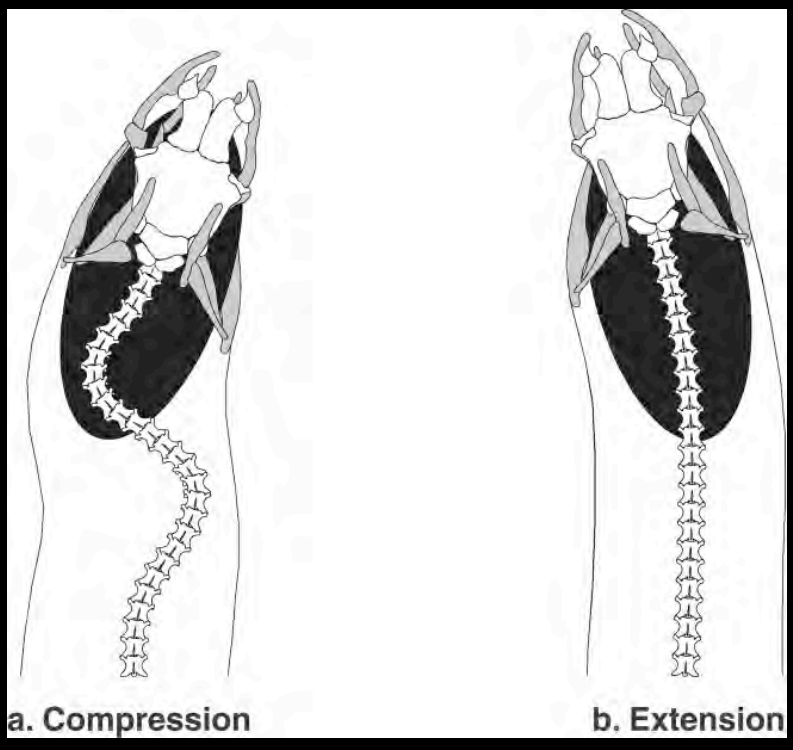
Outline

1) X-ray video
2) X-ray CT and microCT
3) CT in finite element modeling
4) rotoscoping
5) development

x-ray video – skeletal structures

x-ray negative images

“concertina” swallowing



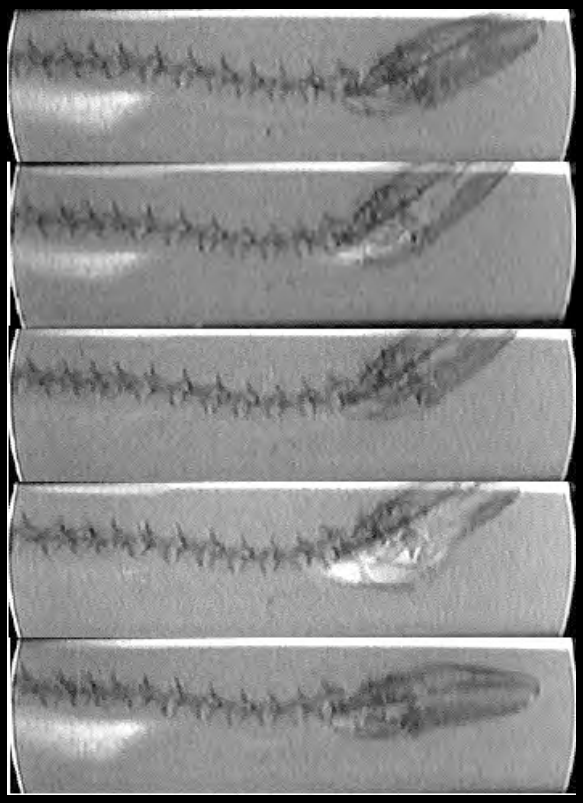
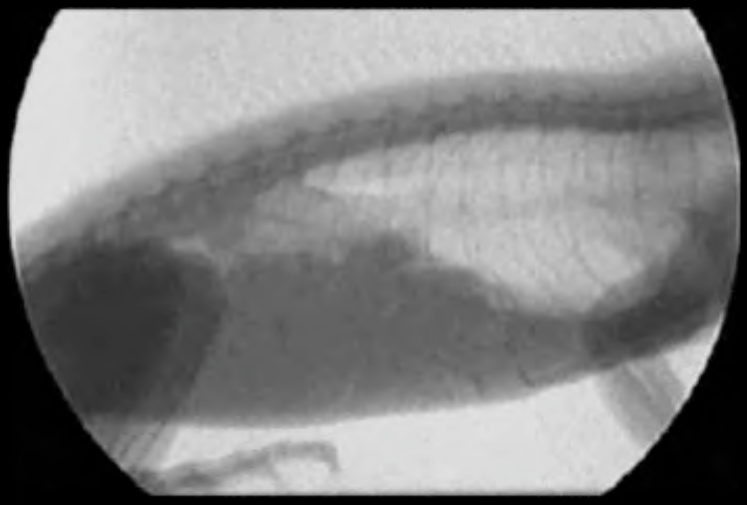


image low density gases

biomechanics of breathing

aspiration breathing

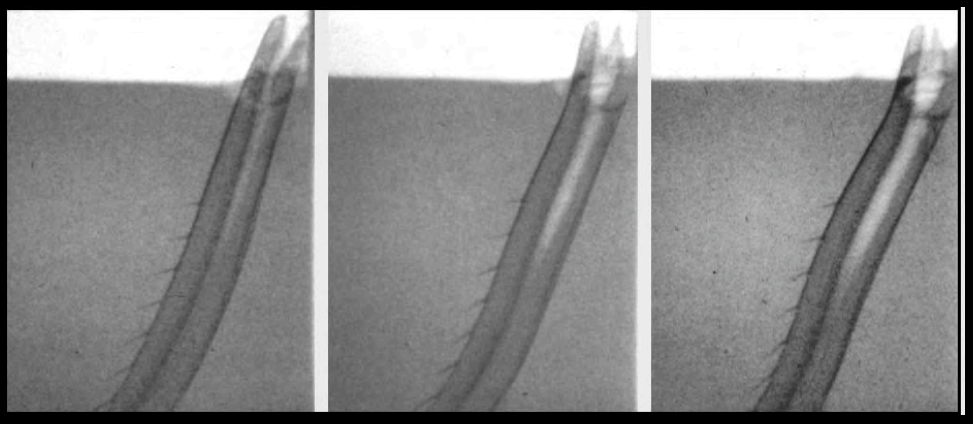
aspiration breathing



aspiration breathing

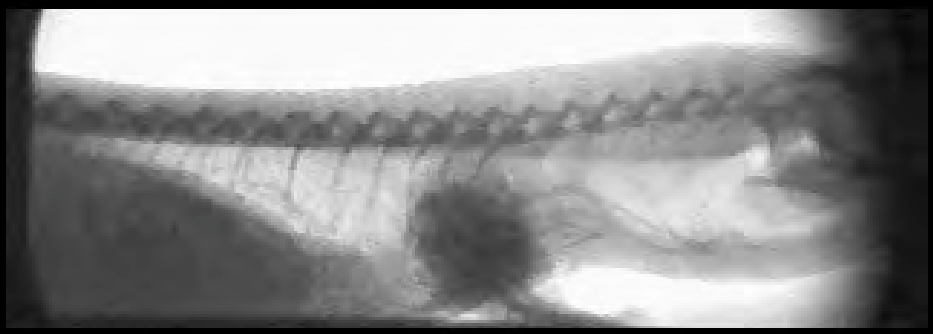
buccal pump breathing

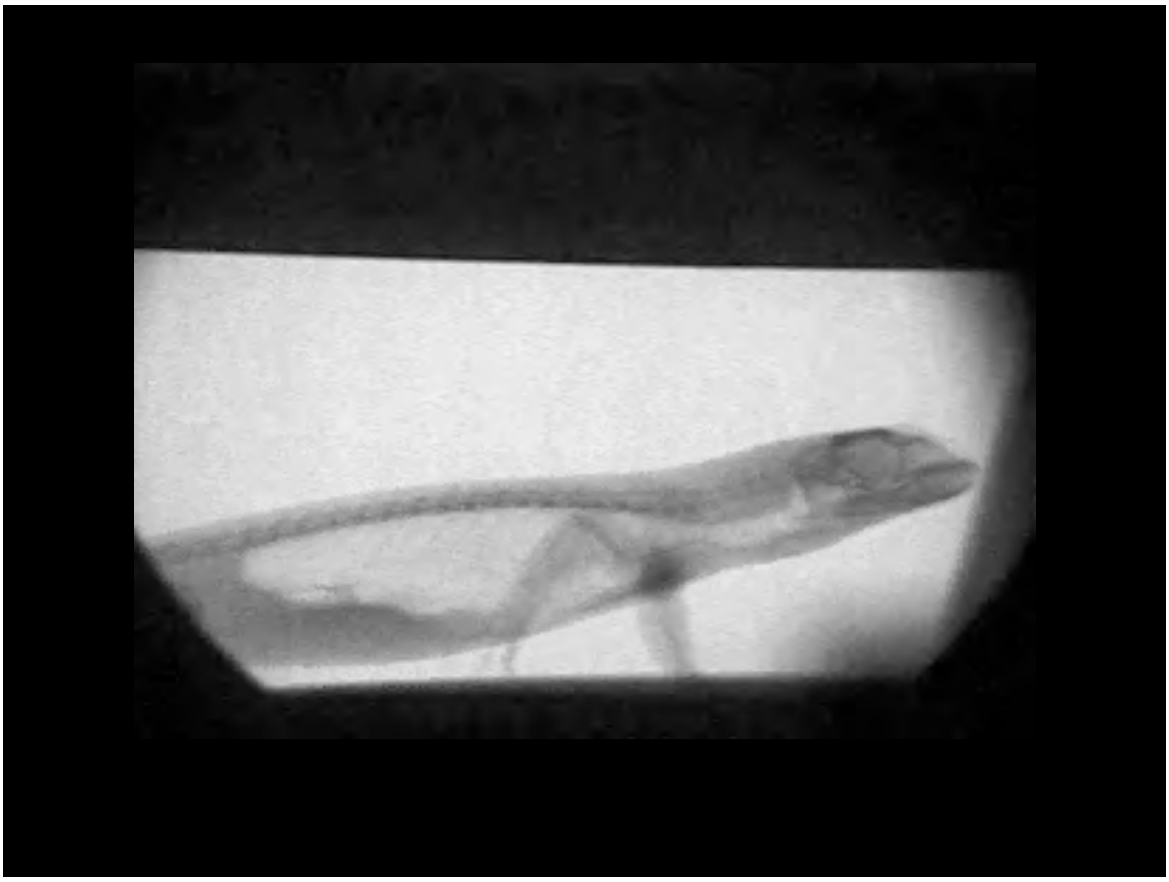
“recoil” aspiration breathing



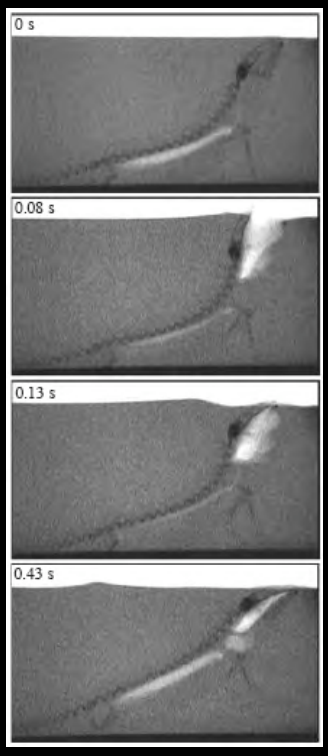
recorded at 200 frames per second

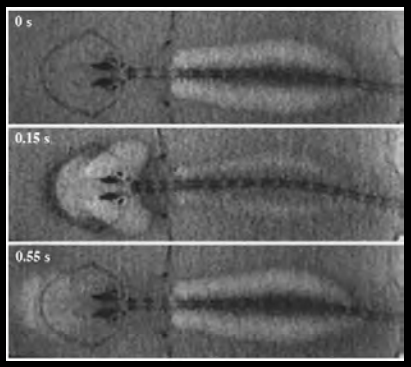
monitor lizard

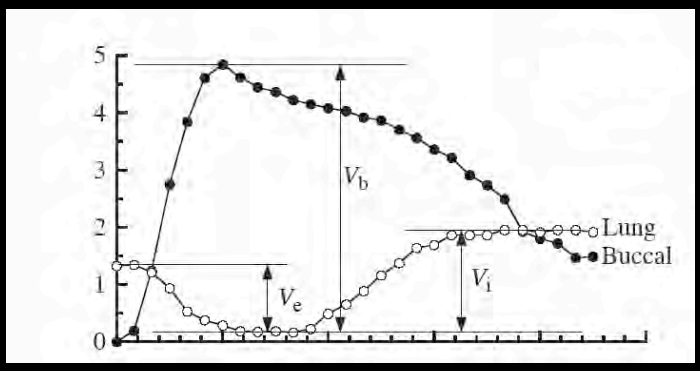




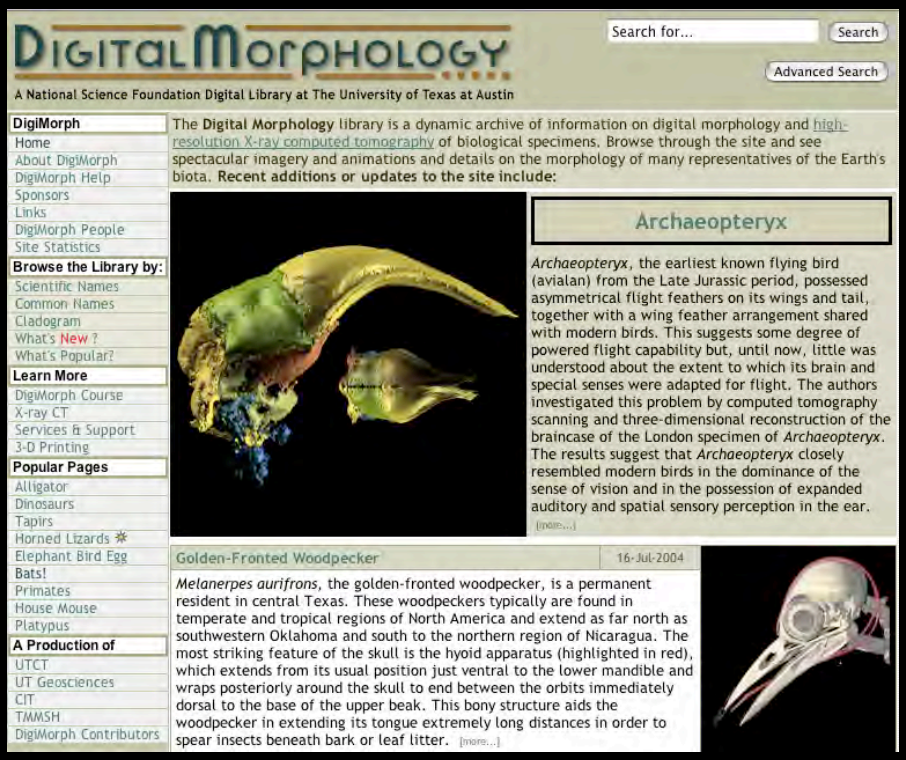
quantitative measurements







X-ray CT and microCT



rapid prototyping

3D printer

Monodelphis

University of Texas at Austin, Computed Tomography Lab,
DigiMorph Project, Tim Rowe, PI

X-ray CT

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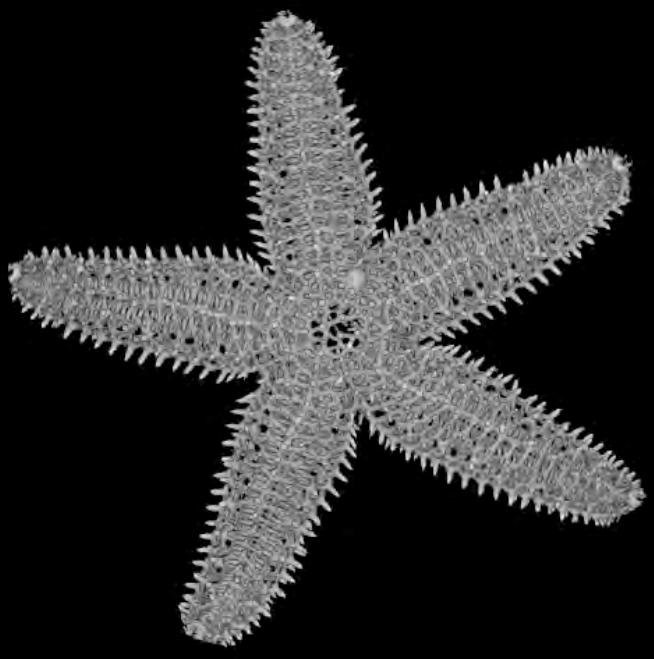
DigiMorph Project, Tim Rowe, PI

X-ray CT



University of Texas at Austin, Computed Tomography Lab,
DigiMorph Project, Tim Rowe, PI

X-ray CT

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DigiMorph Project, Tim Rowe, PI

X-ray CT and finite-element modeling

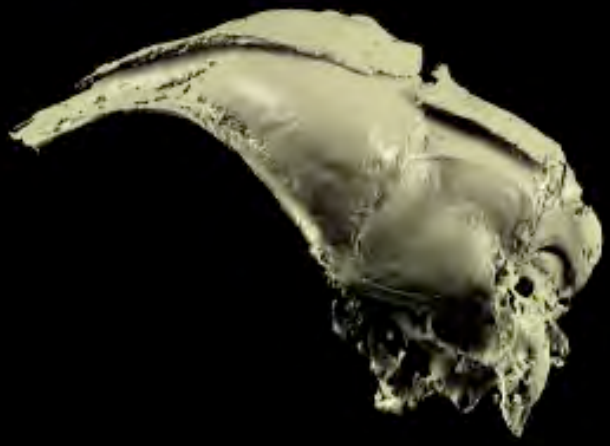
University of Texas at Austin, Computed Tomography Lab,
DigiMorph Project, Tim Rowe, PI

rotoscoping

injected contrast agents

L. Whitmore, Ohio University
from Digimorph library

fossils – *Archaeopteryx*



fossils – *Confuciusornis*

X-ray CT – summary

- skeletons, including fossils
- gas-filled spaces
- injected contrast agents
  (e.g. circulatory system)

- *in vivo* x-ray CT

Developmental Biology

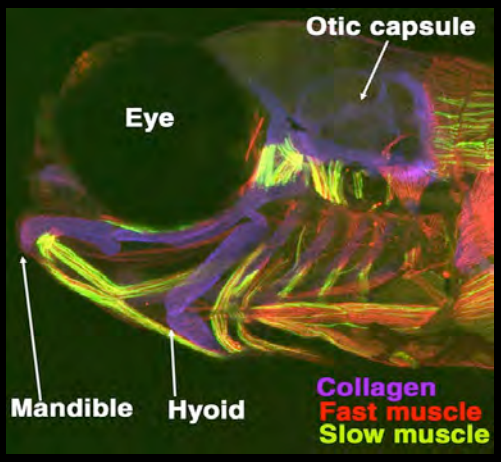


image from L.P. Hernández

confocal microscopy

X-ray imaging, later stages

chick embryo
10 days

X-ray imaging, later stages

chick embryo
20 days

X-ray imaging in developmental biology

good for imaging skeletal development, circulatory system, gas-spaces

later stages of development than confocal microscopy

requirements:
high resolution (10μm)
ideally *in vivo*

Future uses of x-ray imaging and APS

biomechanics of vertebrate
embryos and juveniles may be a good use of APS synchroton imaging