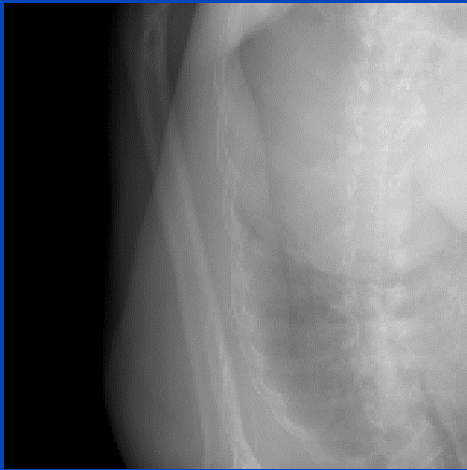


Deep Bone Extraction in X-Ray Projection Domain

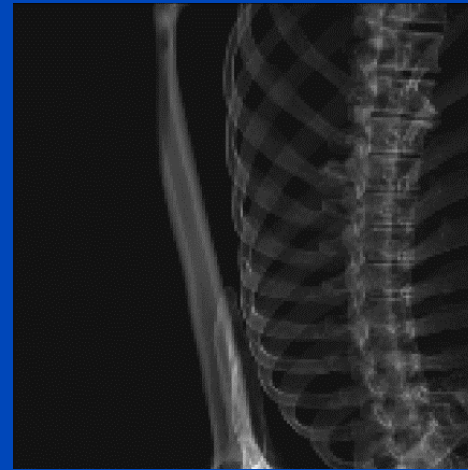
Jonathan Bollig, Fabian Jäger,
and Marc Kachelrieß

German Cancer Research Center (DKFZ)
Heidelberg, Germany
www.dkfz.de/ct

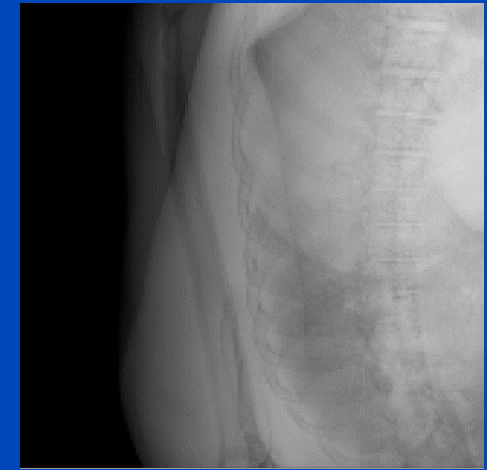
Underlying Concepts



Complete projection

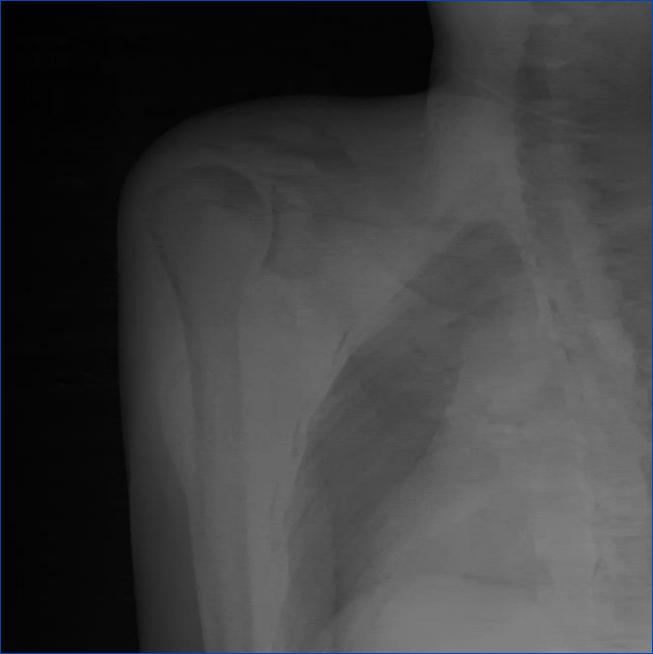
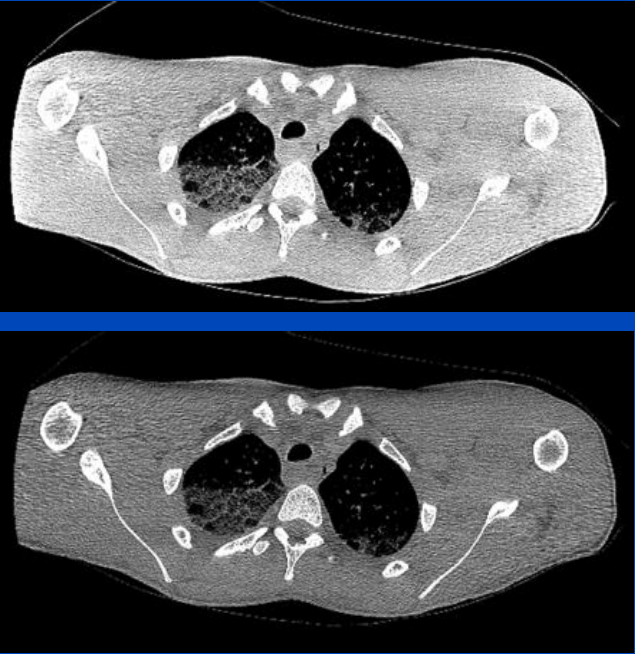



Bone only projection



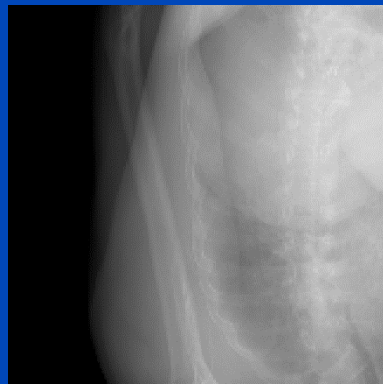
Soft tissue only projection

Motivation

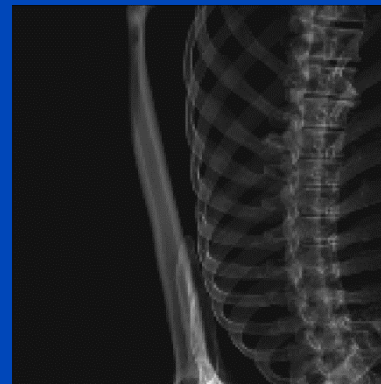
Bone suppression and enhancement	Beam hardening correction	Registration tasks
		

Goal and Method

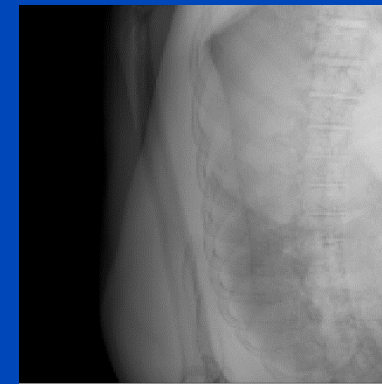
- **Goal:** Extracting the contribution of bones to the beam attenuation measured in X-ray projections
- **Method:** Training a 6-layer UNet on patches of 256×256 pixels to predict the separate bone only and soft tissue only projections from complete projection data, the Deep Bone Extraction (DBE)



Complete projection

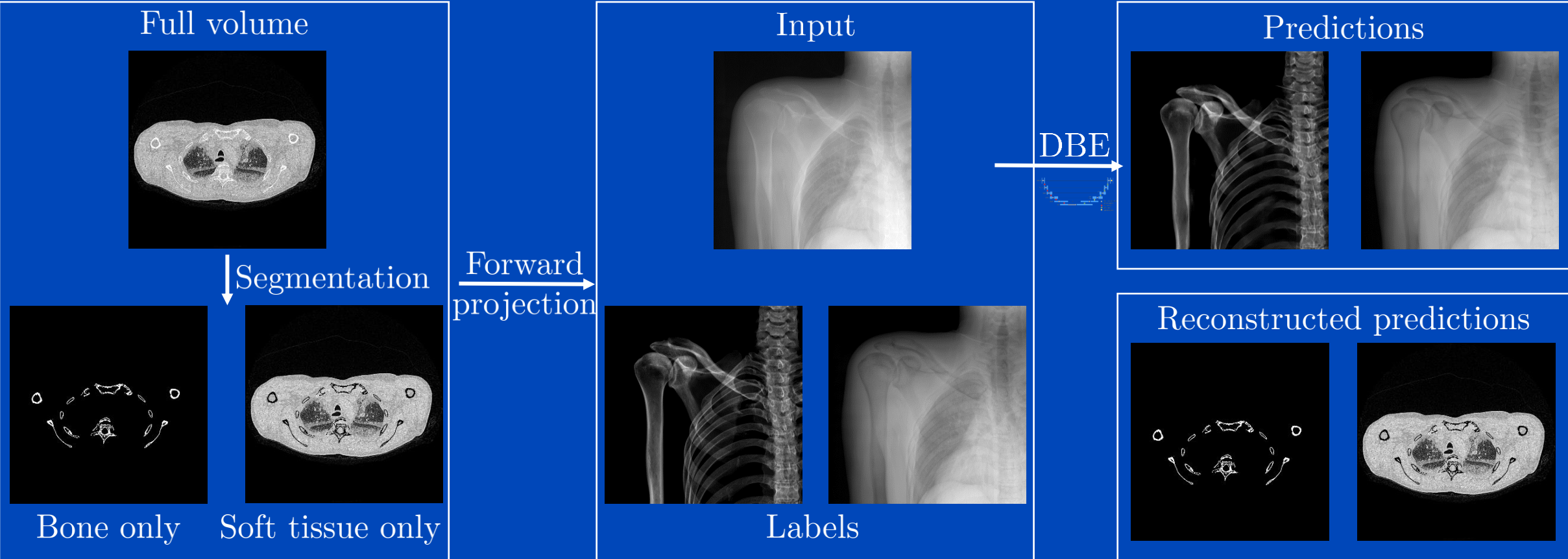


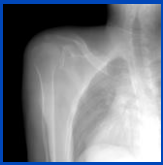
Bone only
projection



Soft tissue only
projection

Workflow





Projection Example

Labels

Predictions

Differences

$C = 0.7, W = 1.4$

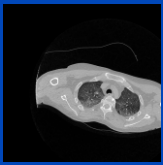


$C = 0.0, W = 0.5$



$C = 2.3, W = 4.6$

$C = 0.0, W = 0.5$



Reconstruction Example

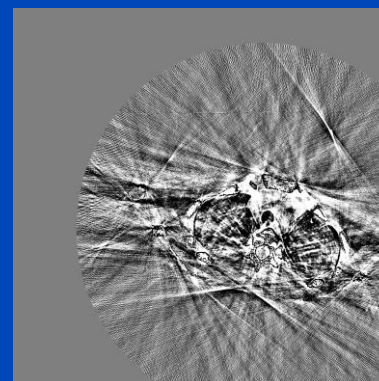
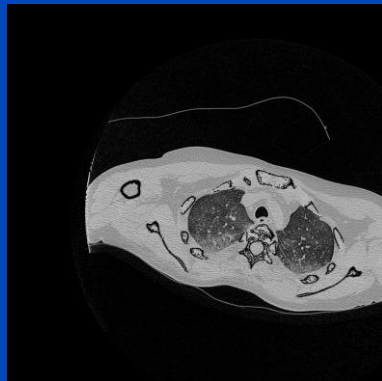
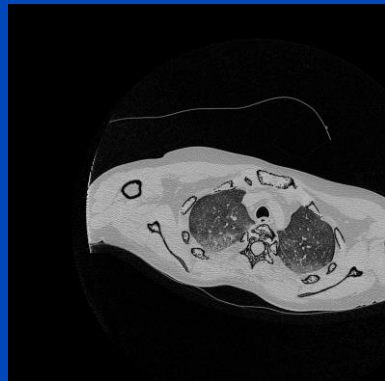
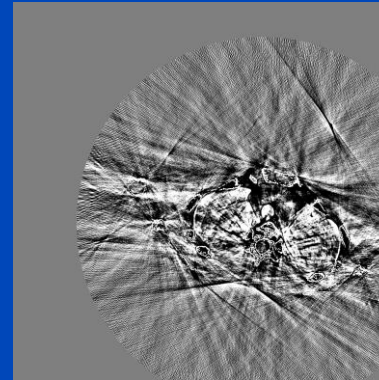
Labels

Predictions

Differences

$C = -500 \text{ HU}, W = 600 \text{ HU}$

$C = 0 \text{ HU}, W = 200 \text{ HU}$

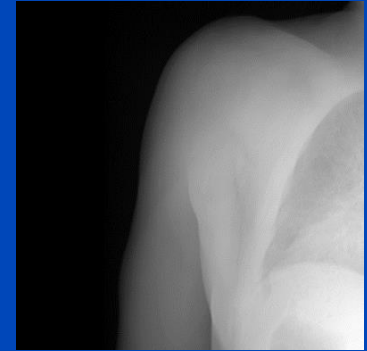


$C = -200 \text{ HU}, W = 1500 \text{ HU}$

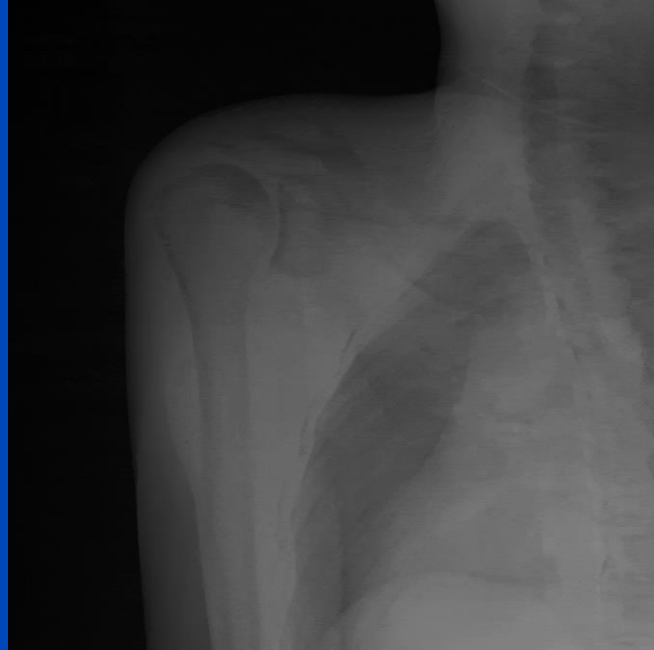
$C = 0 \text{ HU}, W = 200 \text{ HU}$

Discussion

- **2.5D:** including further projections in angular vicinity to the projection of interest as further input channels to the network (CT)
 - Replacing bone with water
 - Different loss functions (e.g. region-specific MSE)
-
- Successful extraction of the contributions of bone and soft tissue
 - Tomographical consistency
 - Improvements may include:
 - Angle-dependent networks
 - Polychromatic training data



Thank You!



This presentation will soon be available at www.dkfz.de/ct.

Job opportunities through DKFZ's international PhD or Postdoctoral Fellowship programs (marc.kachelriess@dkfz.de).

Parts of the reconstruction software were provided by RayConStruct[®] GmbH, Nürnberg, Germany.