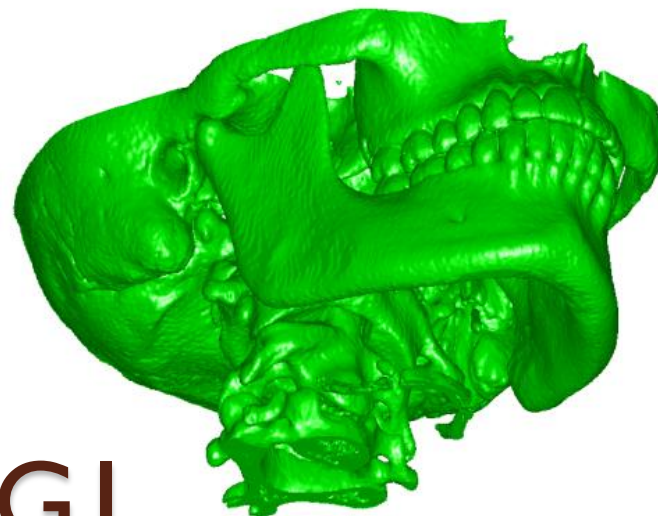


Počítačová tomografie

Computer Thomography - CT



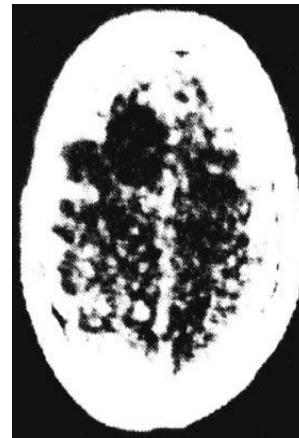
FRVŠ I403/2010/GI

Historie

- Wilhelm C. Roetgen (Něm.)



1895

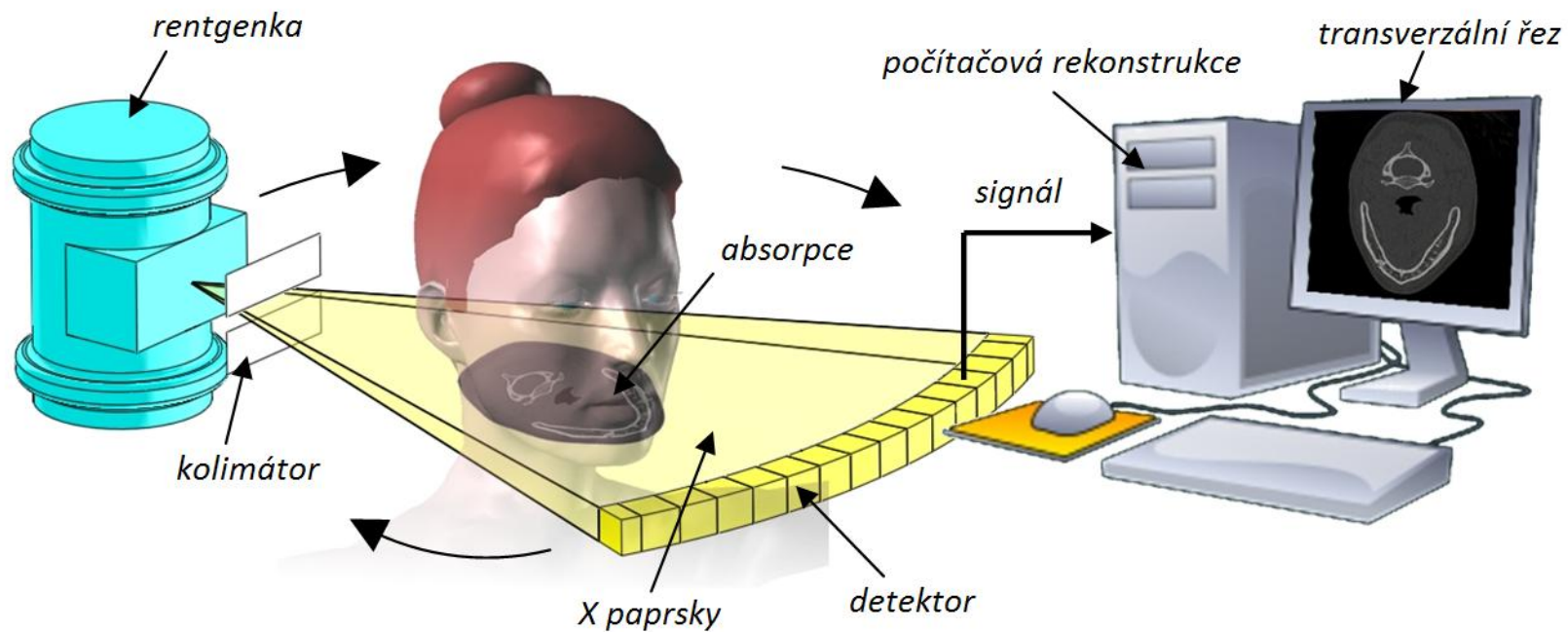


1971



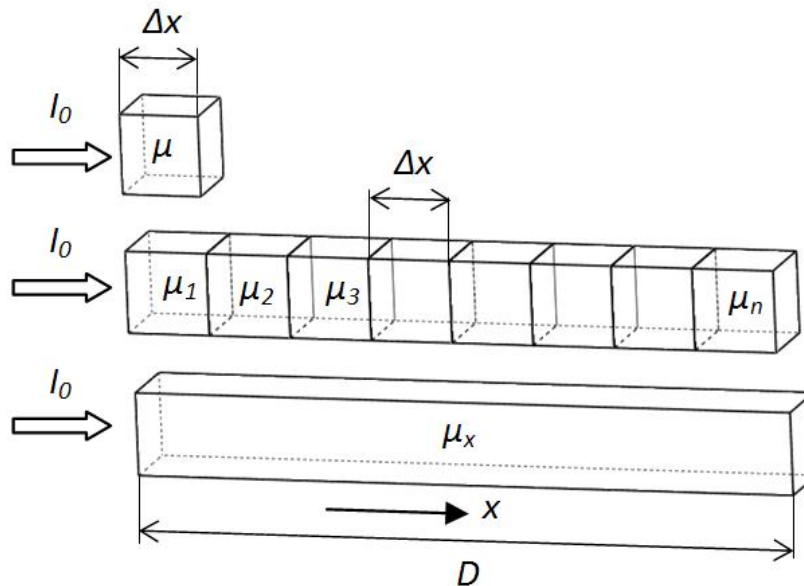
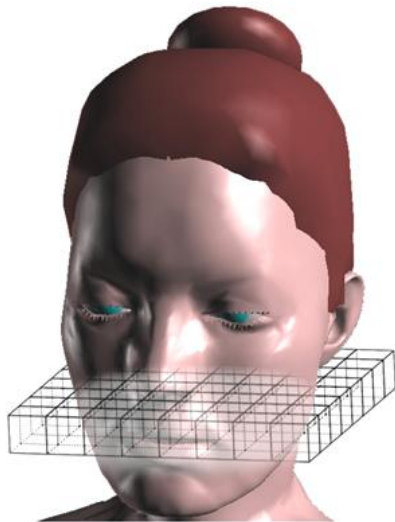
- Godfrey N. Hounsfield (Ang.)

CT zařízení



Princip

- Postup vzniku obrazu (denzito – obraz)
 - Vstupní svazek X záření – I_0
 - Svazek prochází objektem a dochází k absorpci
 - Výstupní svazek je zachytáván detektorem
 - Data se přenesou do PC, kde se řeší soustava **lineárních** rovnic
 - Výsledný obraz



$$I = I_0 e^{-\mu \Delta x}$$

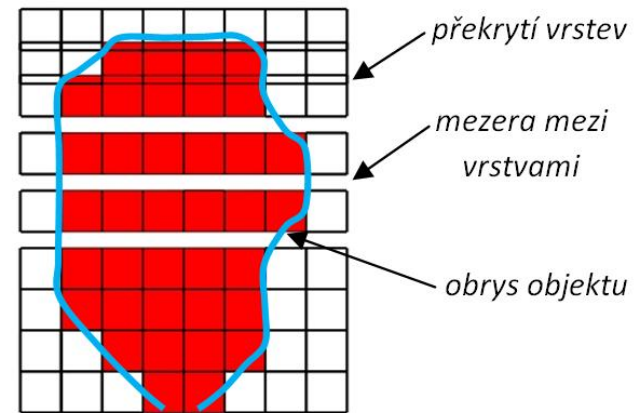
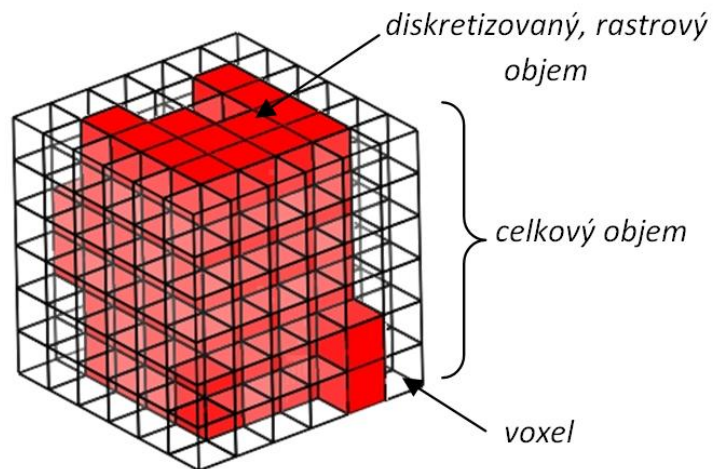
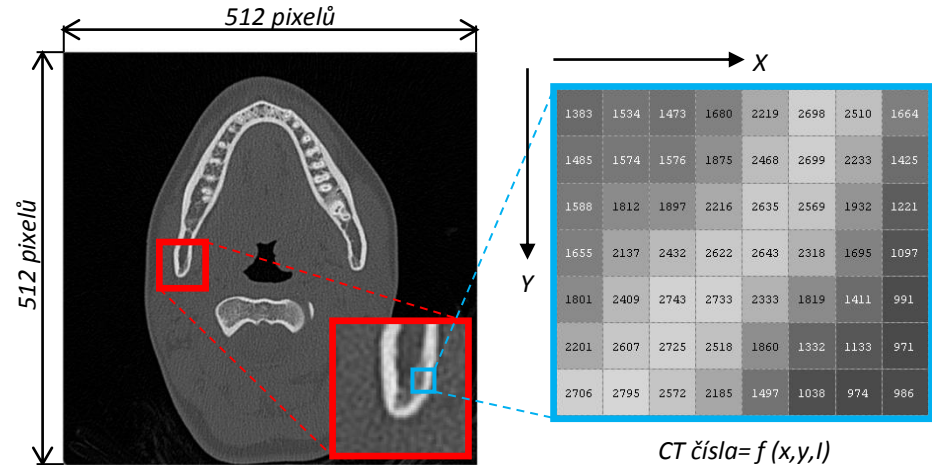
$$I = I_0 e^{-\sum_{i=1}^n \mu_i \Delta x}$$

$$I = I_0 e^{-\int_0^D \mu_x dx}$$

CT snímky

- Rastrová grafika

- Pixel: reprezentuje 2D grafiku
- Voxel: reprezentuje 3D grafiku



DICOM-metadata

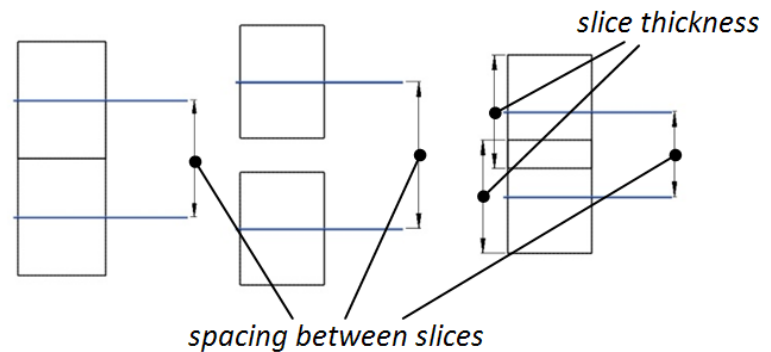
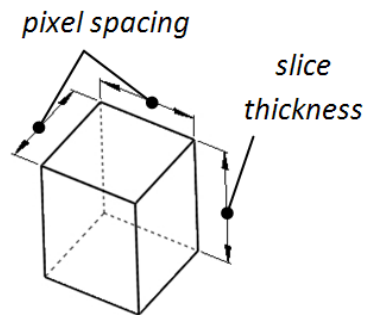
- Digital Imaging and Communications in Medicine

Vlastnosti snímku

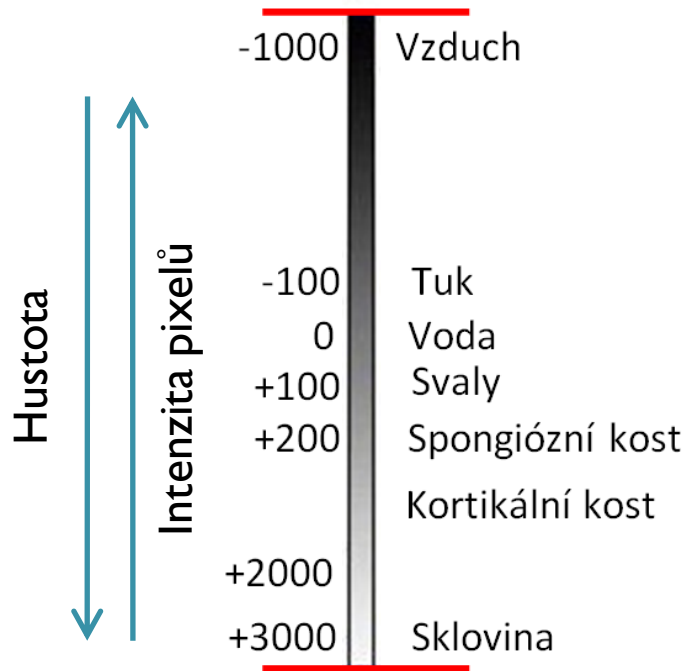
- Width (columns).....512
- Height (rows).....512
- Class.....uint16
- Image type.....intensity
- Minimum intensity.....0
- Maximum intensity.....3332

Metadata

- Filename: CIM-0001-0113.dcm
- FileModDate: 07-XI-2006 14:32:38
- FileSize: 526866
- Format: DICOM
- FormatVersion: 3
- Width: 512
- Height: 512
- BitDepth: 12
- ColorType: grayscale
- FileMetaInformationGroupLength: 202
- FileMetaInformationVersion: [2x1 uint8]
- ...



Hounsfieldovi jednotky

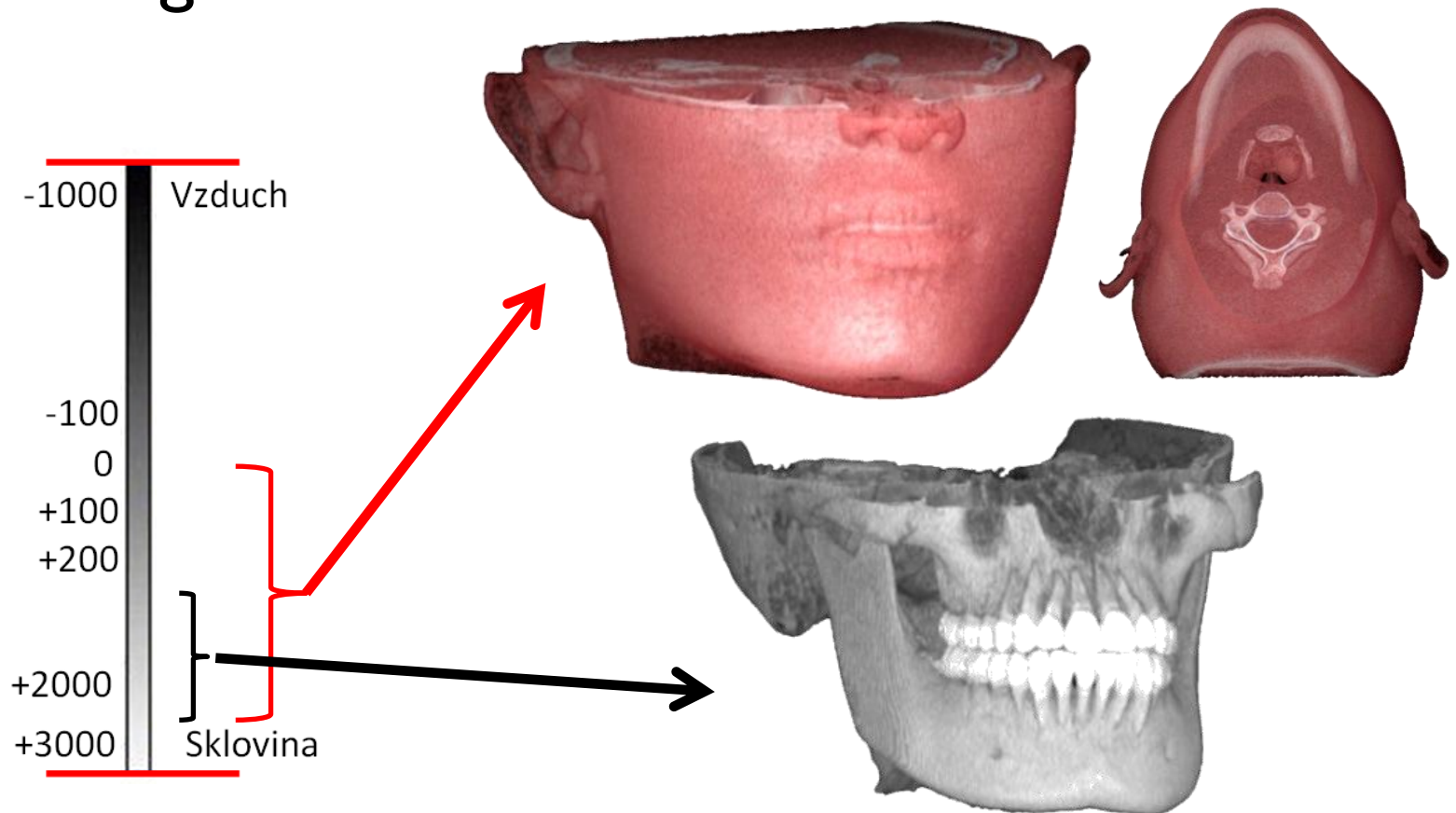


$$HU = 1000 \cdot \frac{CT - CT_w}{CT_w - CT_a}$$

Tkáň	Hounsfield units - HU
Vzduch	-1000
Voda	0
Svaly	35-70
Vazivové tkáně	60-90
Chrupavka	80-130
Spongiózní kost	150-900
Kortikální kost	900-1800
Dentin	1600-2400
Sklovina	2500-3000

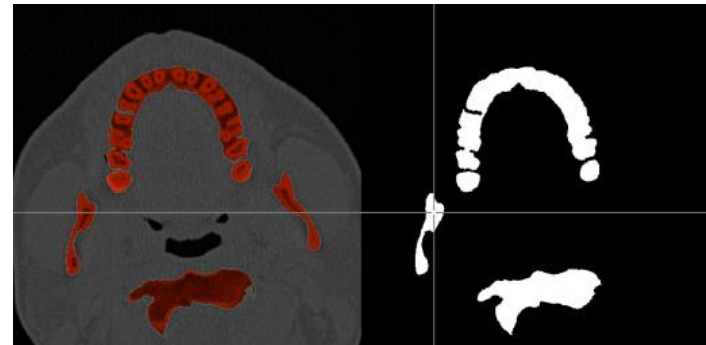
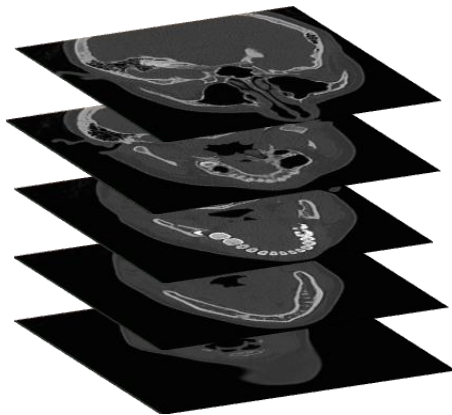
Image processing

- Voxel - software viewer3D
- Segmentace



Metody segmentace

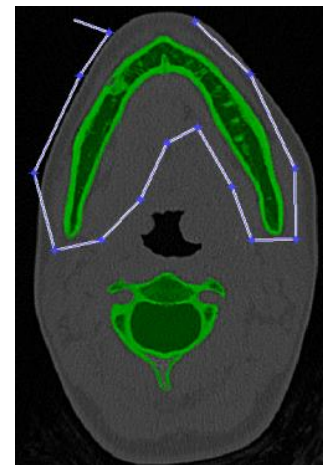
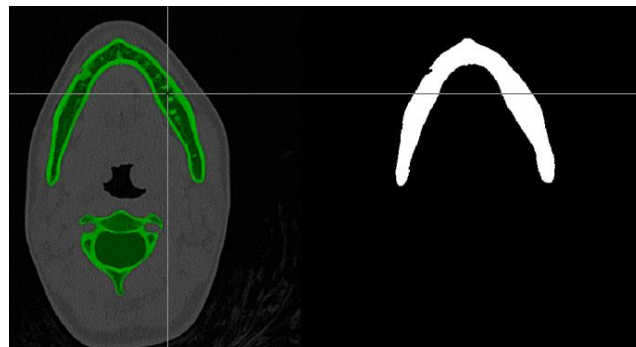
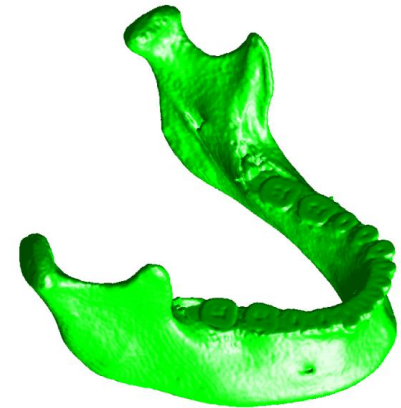
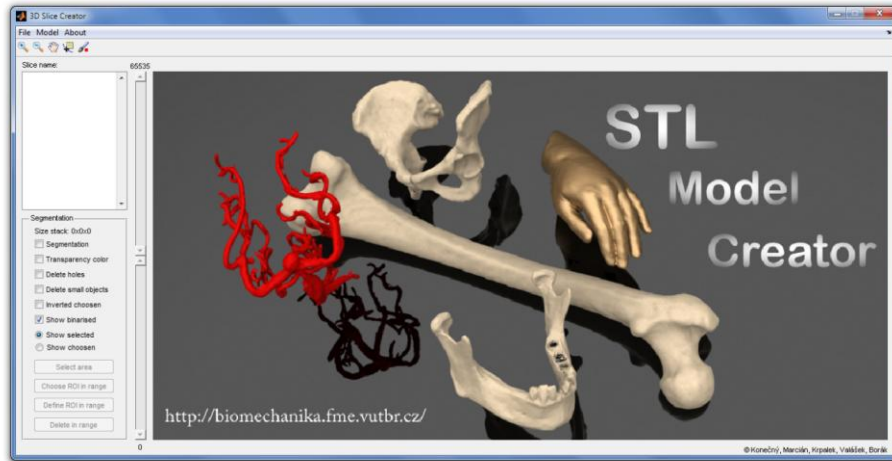
- Automatická segmentace
 - prahování: Tresholding, Clustering
 - hranové detektory
- Manuální segmentace
- Hybridní segmentování



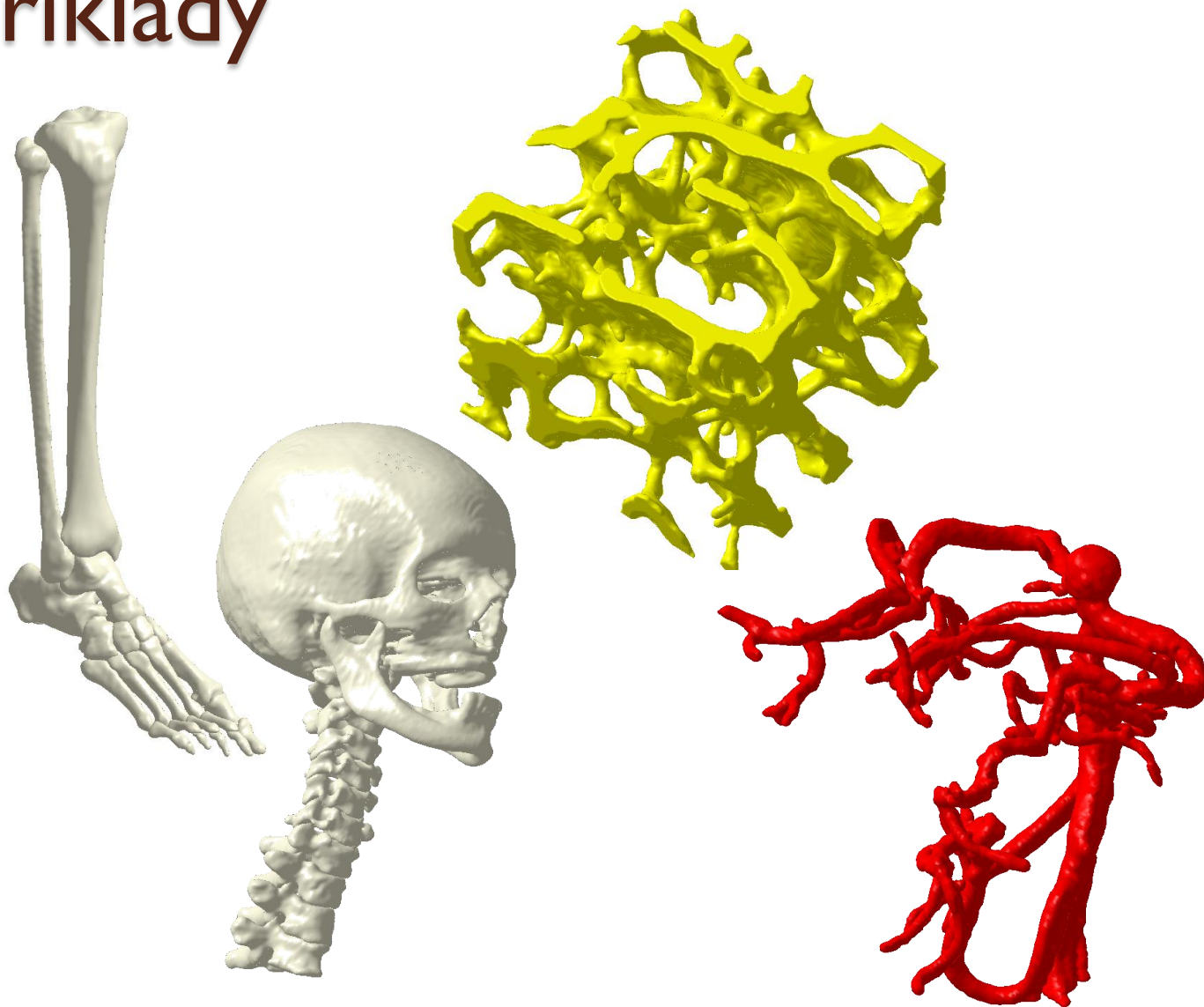
Software

- Mimics (Materialise) - Belgie
- ScanIP - Anglie
- Amira - USA
- 3D doctor - USA
- Transfer – Česká republika
- Vascops – Švédsko, Rakousko
- **STL Model Creator**

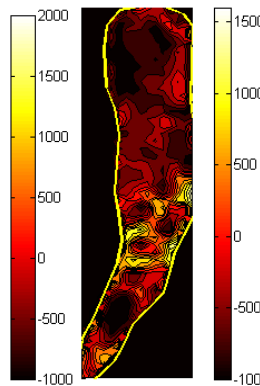
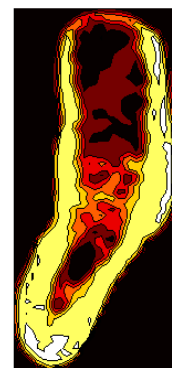
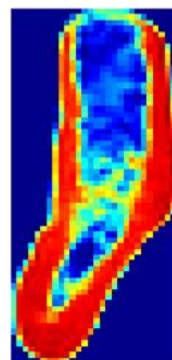
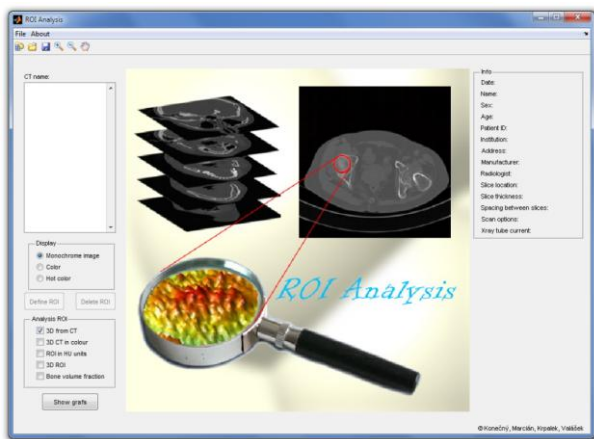
STL Model Creator



Příklady



Dentální CT vyšetření



D1



D2



D3



D4

Hustota	Misch	Norton and Gamble	Rubelisa
D1	1250	> + 850	> + 400
D2	+ 850 to + 1250	+ 500 to + 850	+ 200 to + 400
D3	+ 350 to + 850	+ 500 to + 850	+ 200 to + 400
D4	+ 150 to + 350	0 to + 500	< + 200
D5	< 150	-	-

Zhodnocení

- **Výhody**
 - Rychlá efektivní tvorba geometrie
 - Sledování vnitřní struktury
 - Diagnostika
- **Nevýhody**
 - Přesnost – artefakty
 - Nebezpečné zdraví škodlivé záření