

# 3D CT PHOTOREALISTIC VISUALIZATION SUPPORTED BY HPC COPROCESSORS

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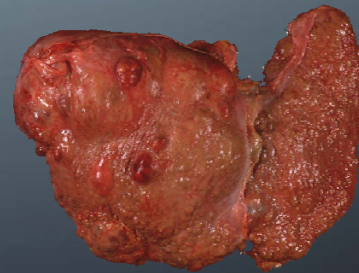
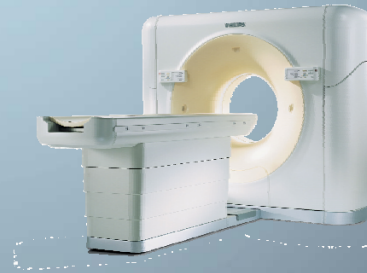
GPU DAY 2016 - THE FUTURE OF MANY-CORE COMPUTING IN SCIENCE

BUDAPEST  
JUNE 03, 2016

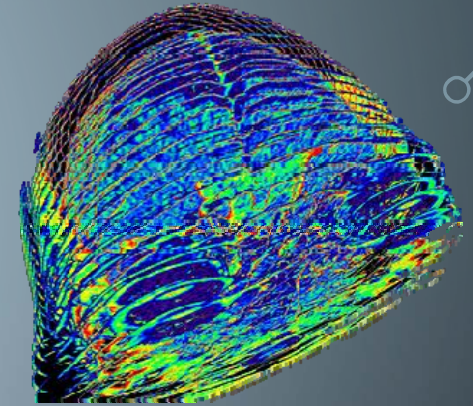


# RESEARCH WORK AT IT4I - INTRODUCTION

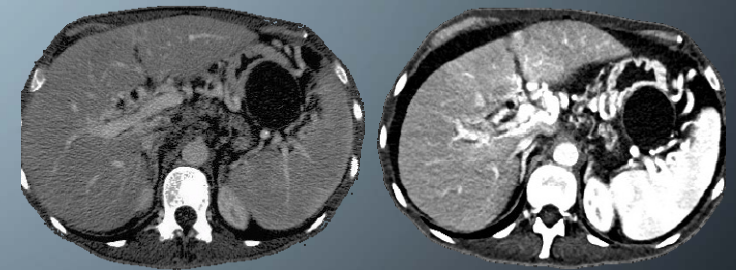
- CT important role in medicine
- HPC coprocessing:
  - Preprocessing
  - Segmentation
  - Postprocessing
  - 3D visualization
- Liver Cancer (WHO: 1 million/year):
  - Organ volume



# PRE-PROCESSING

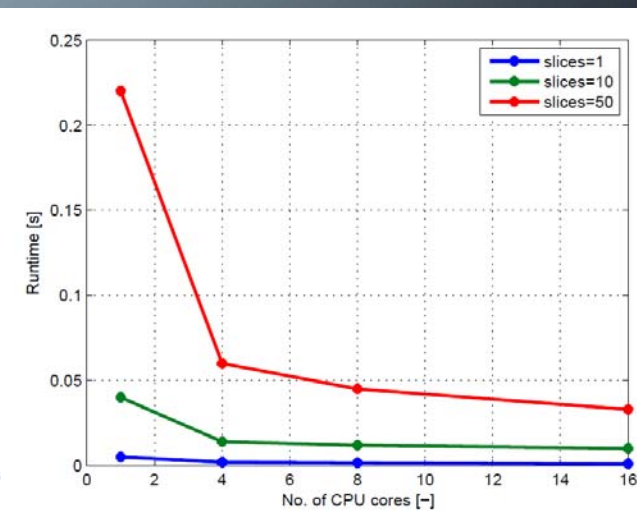
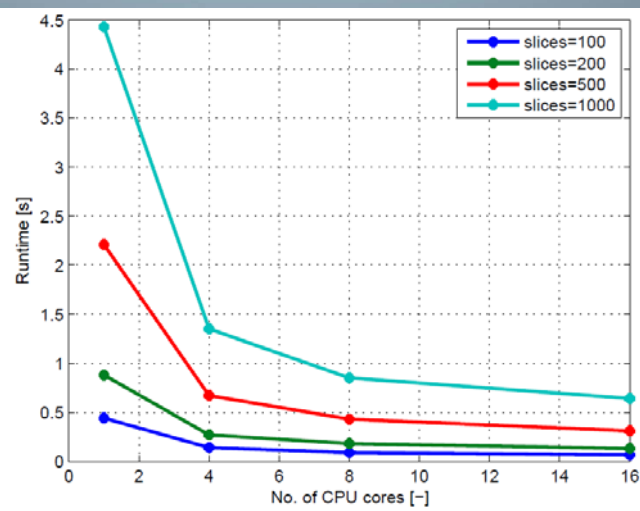
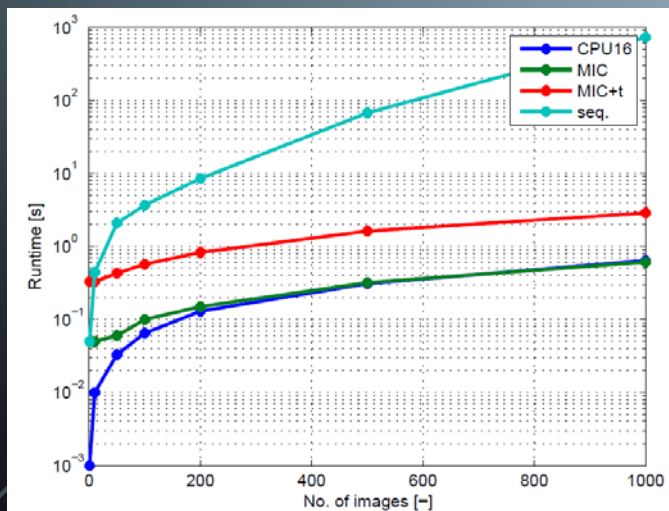
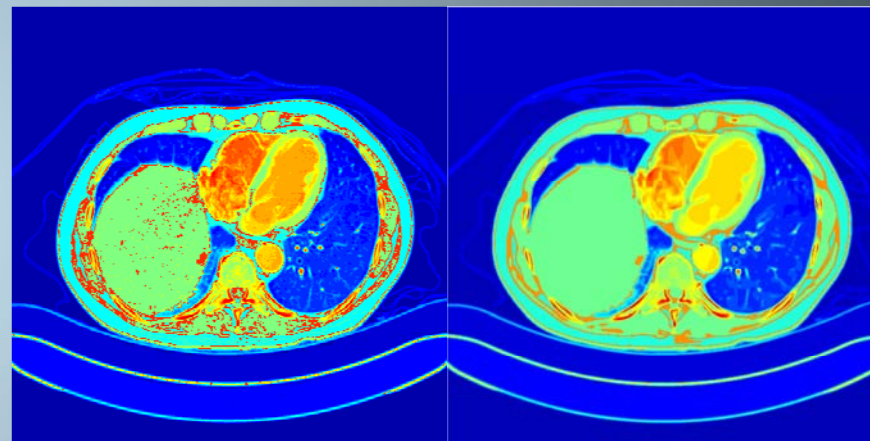


- Retrieve CT image slices from DICOM (high resolution => axial slices 0.6mm)
- Random noise => noise reduction
  - Gauss smoothing
  - Block-matching and 3D filtering (BM3D) algorithm
- Mapping:
  - Pixel intensity transformation from CT to Hounsfield Units (HU; Bones: +700; air:-1000; liver: +40<+60)
  - linear transformation of the data:  $hu = pixelvalue * Rescale\ Slope + Rescale\ Intercept$
- Data conversation into a image vector



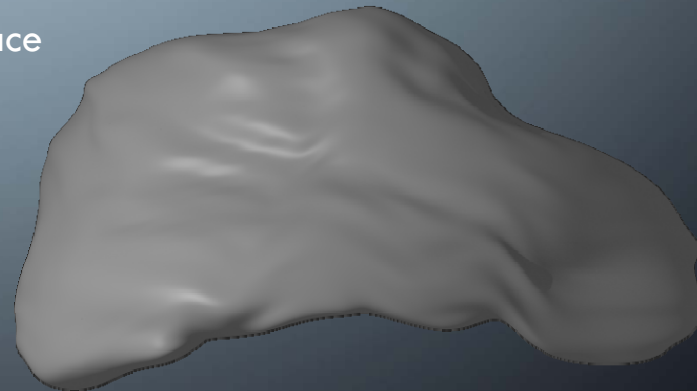
# SEGMENTATION

- K-means algorithm:
  - based on image histogram, and distances (parallel way)
  - Histogram compress



# POST-PROCESSING

- Reconstruction of the surface
  - flood algorithm (boundary of a segment)
  - Marching cube methods
    - 3D reconstruction algorithm, based on thresholding pixel information
    - extracts iso-density surfaces to find an iso-surface



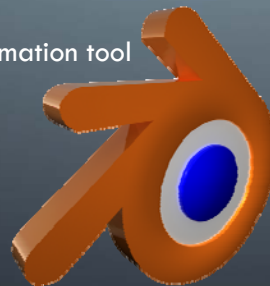


# VISUALIZATION

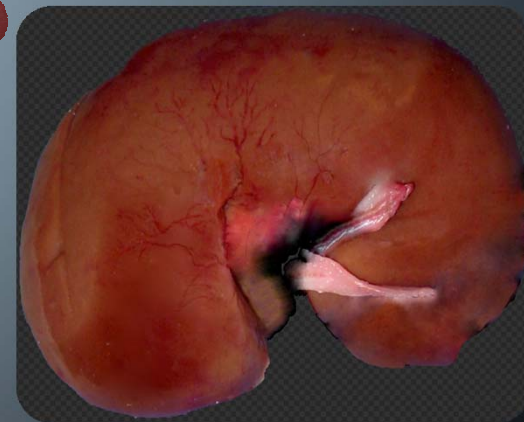
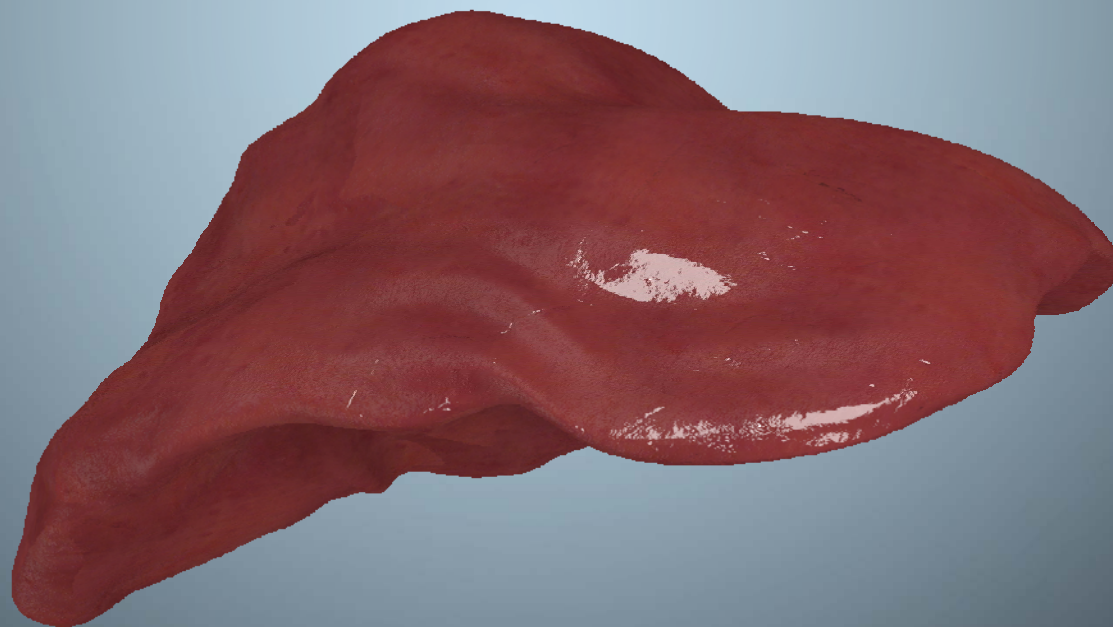
- OpenSceneGraph (OSG):
  - High performance visualization tool
- Leap motion sensor
  - Hand-tracker
  - 200fps – 150°fov
- Oculus Rift
  - Virtual reality glasses/monitors
  - Tracker head movement
- Real VR with combining Oculus and leap
- Blender
  - Realistic photo and 3D visualization animation tool



OpenSceneGraph 

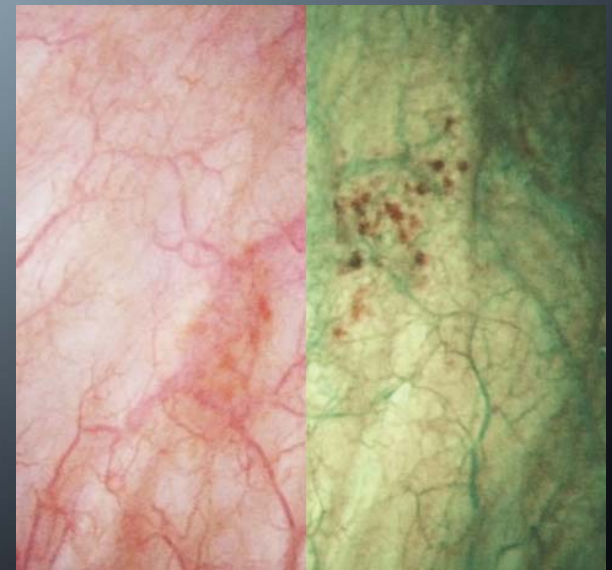


# VISUALIZATION RESULTS – VIDEOS



# FUTURE WORK

- Extend to visualize full human body
- Improve the VR mode with visualize the real hands
- Tobii eyex eye tracking controller
- Planned common work:
  - VKSZ
    - Endoscope visualization
  - H2020





The background is a dark blue gradient with faint, glowing circuit patterns in the corners. The text is centered in a white, sans-serif font.

THANKS FOR YOUR ATTENTION!