



Department of Biomedical Systems,  
Moscow State Institute of  
Electronics Technology (Technical University)

# Panoramic ultrasonic imaging

*Presented by Vera Degtiareva*

Supervisor: Michael N. Rychagov, Prof., Dr.Sc.

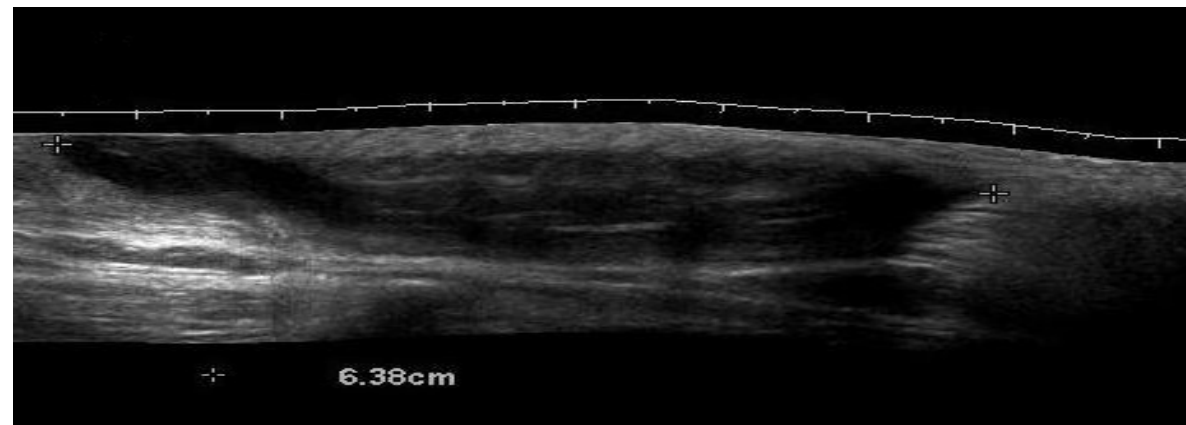
*MB-JASS 2011*

# General information



**Problem:** *As a result of the limited aperture, only the limited view can be obtained with a fixed transducer position*

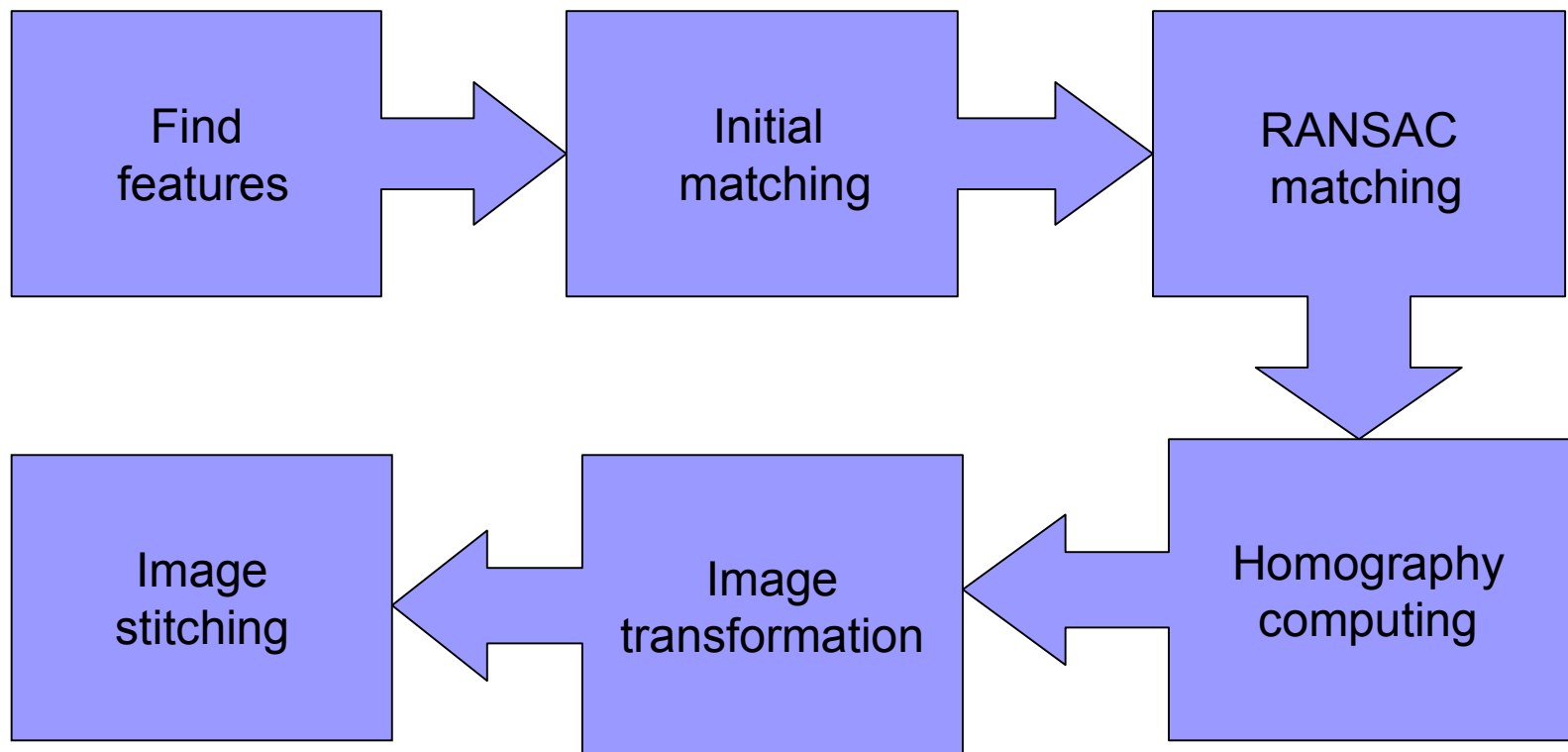
**Task:** *In many applications it is desirable to get a more comprehensive overview of the region of investigation*



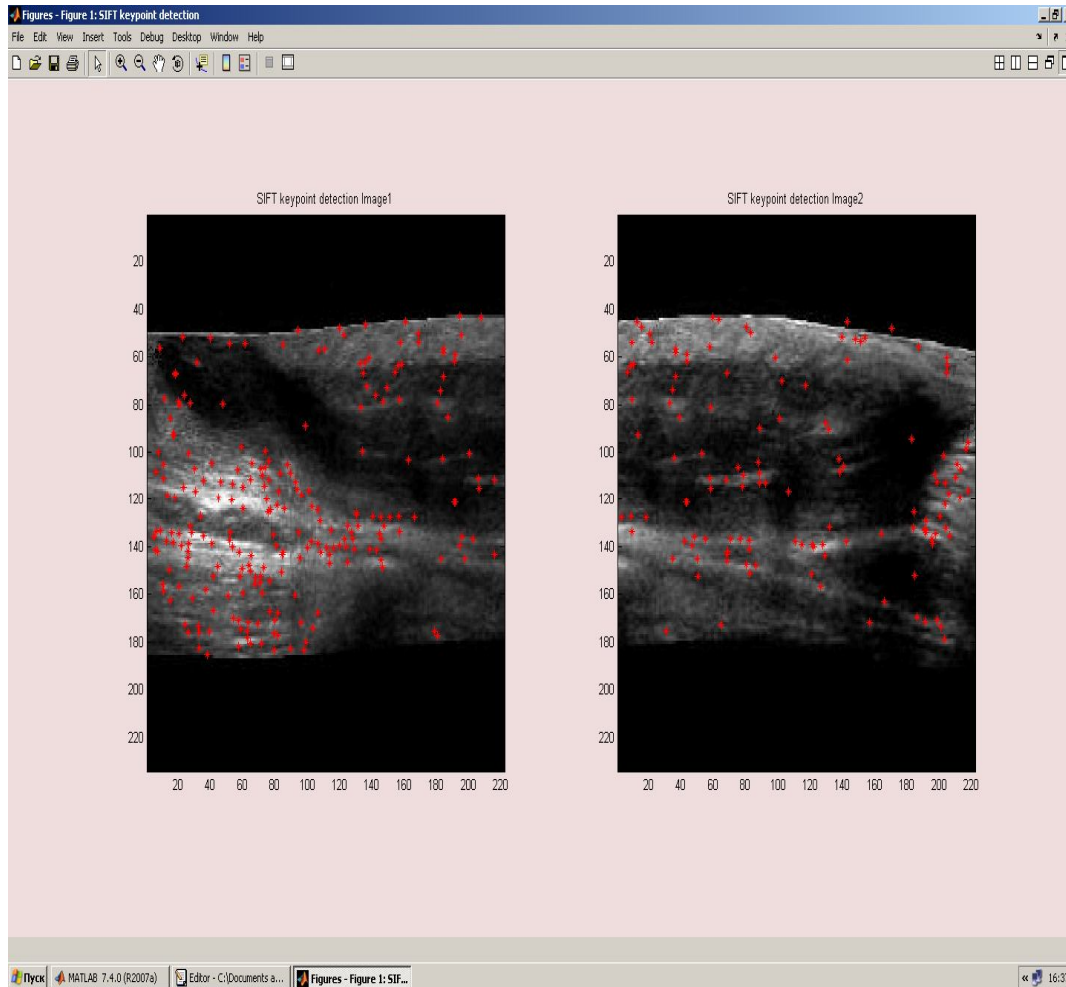
**Solution:** *Recover in-plane transducer motions and combine the information into a single panoramic image*

**Method:** *Numerical modeling using Matlab*

# Main steps



# Find features



$$L(x, y, \sigma) = G(x, y, \sigma) * I(x, y),$$

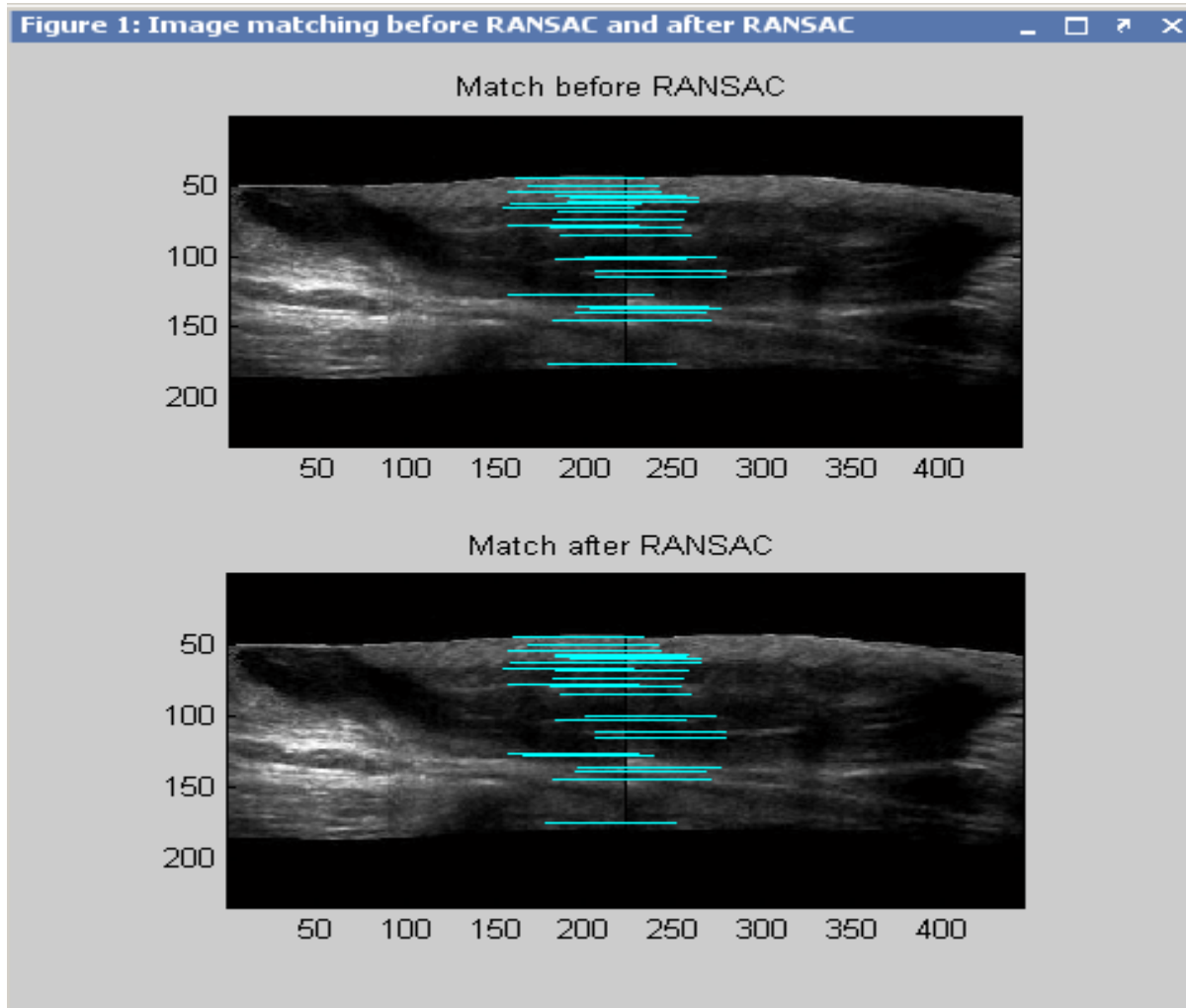
where L — value of Gaussian  
in a point with coordinates (x,y),  
 $\sigma$  — radius of blurring,  
G — Gaussian core,  
I — input image,  
\* — convolution operation .

$$D(x, y, \sigma) = (G(x, y, k\sigma) - G(x, y, \sigma)) * I(x, y) = L(x, y, k\sigma) - L(x, y, \sigma).$$

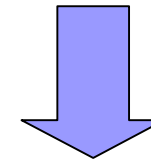
\*\*\*\*\*Image1 - Image2\*\*\*\*\*

Finding keypoints 1...  
260 keypoints are found.  
Finding keypoints 2...  
148 keypoints are found.

# Image matching

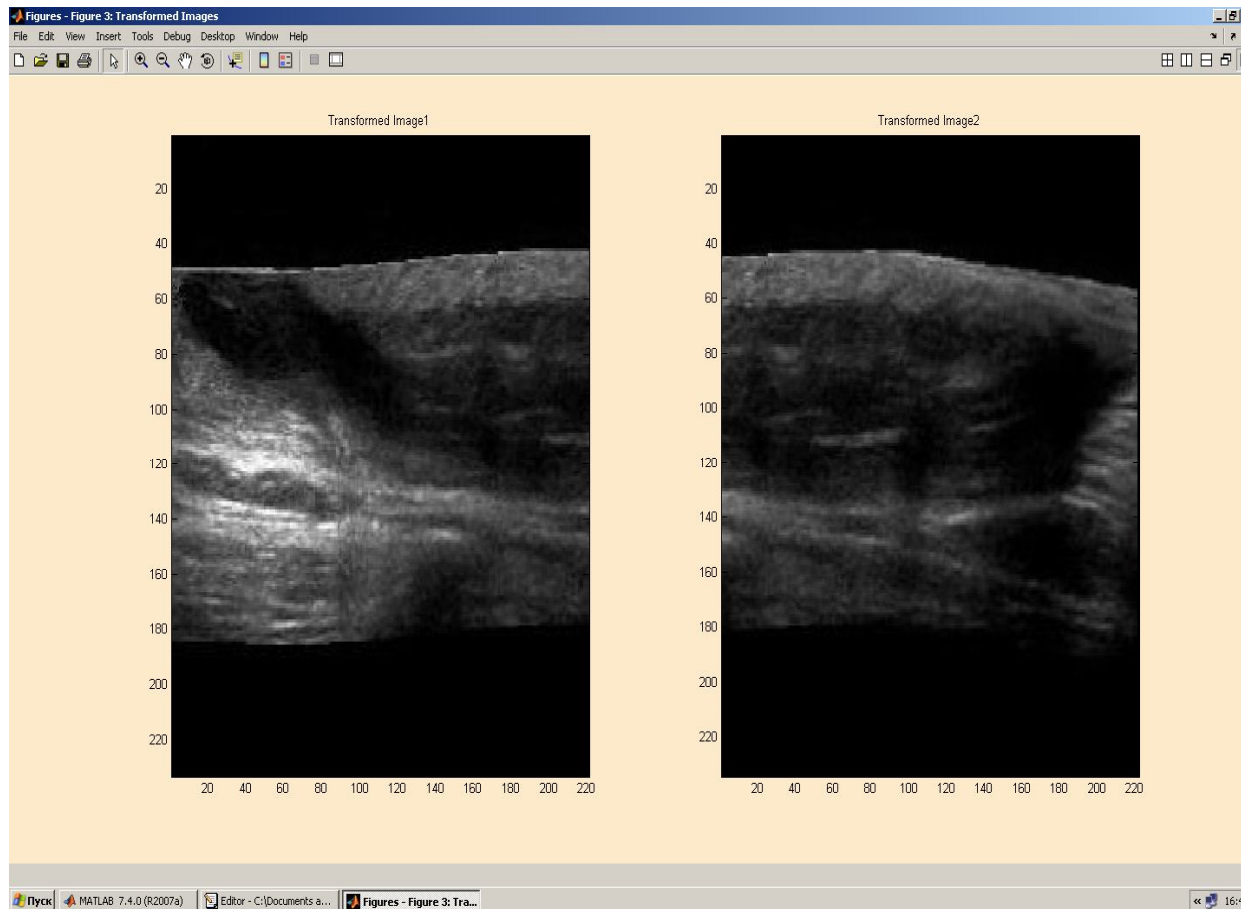


Initial match found : 28 matches.  
RANSAC match found: 26 matches.



**2 false matches**  
were removed by  
RANSAC algorithm

# Image transformation



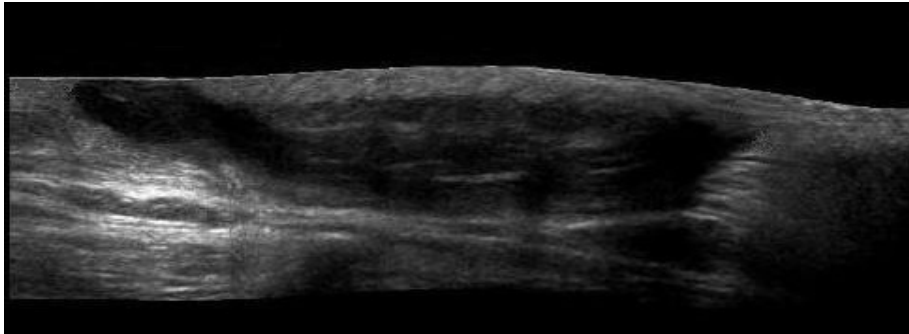
$$H1=H1\_0= [1 \ 0 \ 0; 0 \ 1 \ 0; 0 \ 0 \ 1]$$

$$H2=H1\_0*H2\_1$$

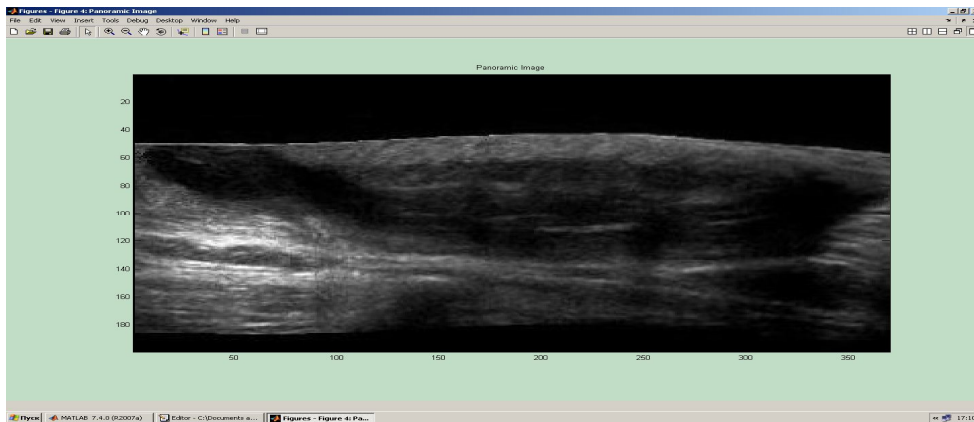
$$H2 =$$

$$\begin{bmatrix} 0.9867 & 0.0032 & 147.9864 \\ -0.0068 & 1.0006 & 0.1231 \\ -0.0001 & 0.0000 & 1.0000 \end{bmatrix}$$

# PSNR based image quality estimation



Original modeling image



Final panoramic image

PSNR – Peak Signal-to-Noise Ratio

$$PSNR = 20 \log_{10} \left( \frac{1}{rms} \right),$$

where *rms* – root mean square difference between two images

PSNR = +44.46dB

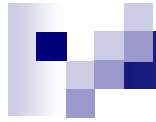
This value indicates that the stitching is of high quality



# Conclusion

- Panoramic images were generated from two and several ultrasonic images received by linear array
- Developed program module has good runtime performance and stability
- Final panoramic image is of high quality
- At present, modeling data for phased array are obtained





**Thank you for your attention!**