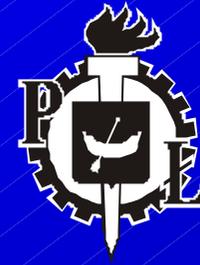




P o l i t e c h n i k a Ł ó d z k a
Instytut Elektroniki



WAVELET MODULE FOR MAZDA

Marcin Kociolek

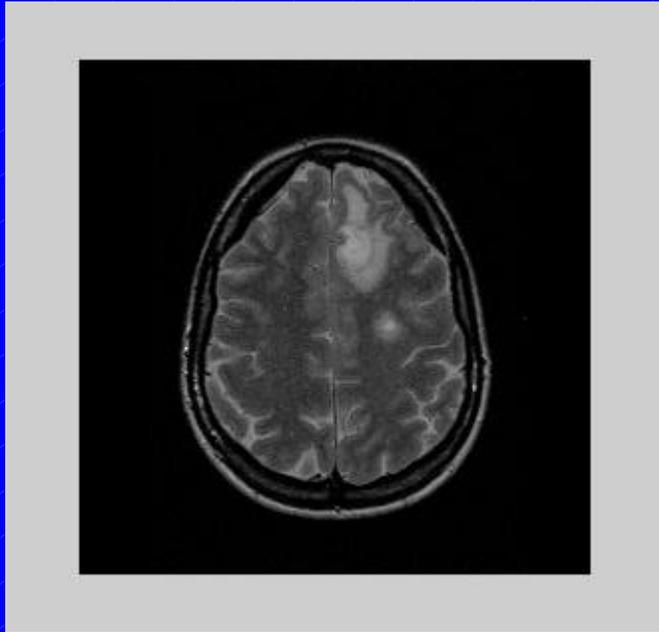
Plan of presentation

- Discrete Wavelet Transform
- Wavelet features
- Wavelet MaZda module
- Test of wavelet module
- Conclusion

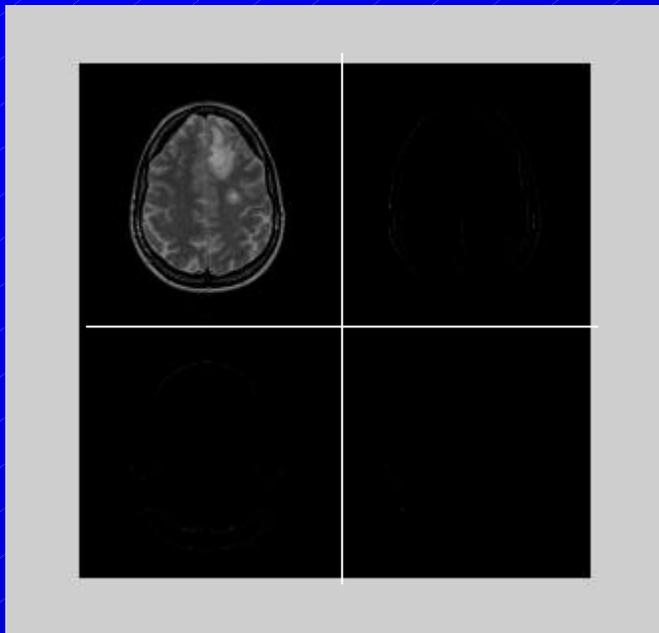
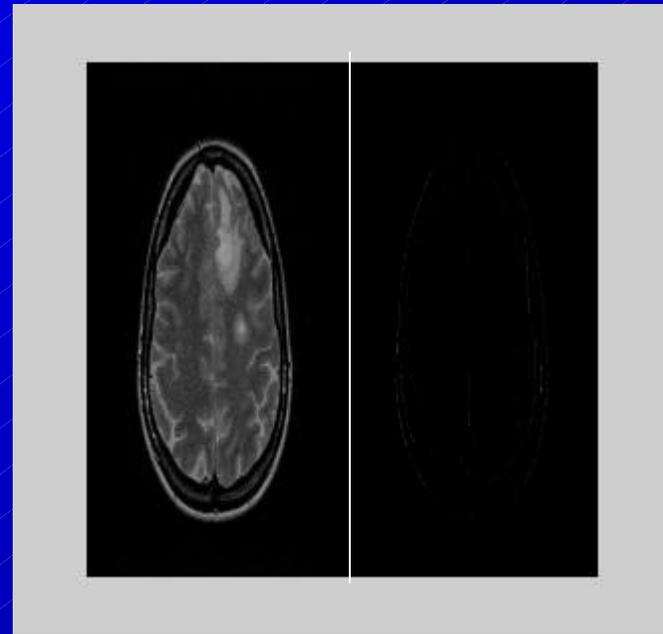
DWT pyramidal algorithm



DWT on images

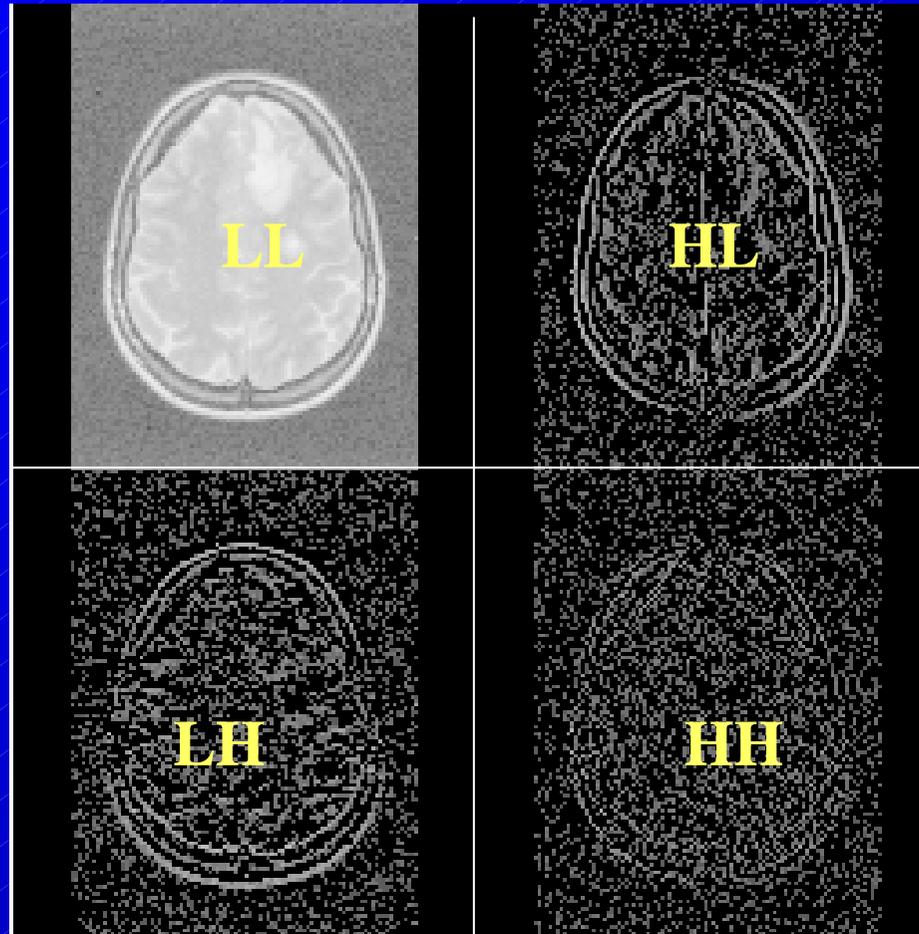


**DWT
in rows**



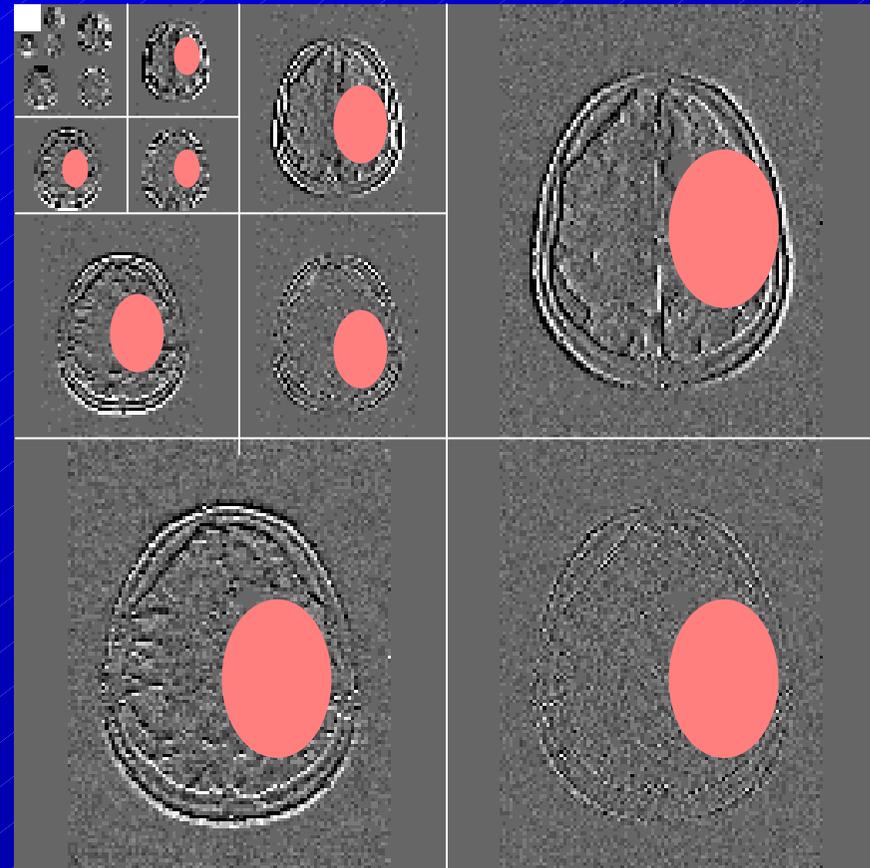
**DWT
in columns**

DWT on images



Wavelet texture features

$$E_{subband, scale} = \frac{\sum_{x,y \in ROI} |w_{i,x,y}|^2}{n}$$



Wavelet MaZda module

The screenshot displays the MaZda software interface. The main window shows a brain MRI scan with a red region of interest (ROI) highlighted. A table of parameters is visible, including Aarm, Teta1-4, and Sigma. A settings dialog box titled 'Mazda - options' is open, showing the 'Wavelets' tab with options for 'Wavelet bits/pixel' (ranging from 4 to 12) and 'Wavelet features' (Calculate Energy, Calculate Moment, Show Map).

Parameter	Value 1	Value 2	Value 3	Value 4	Value 5	Value 6
Aarm =	0	0	0	3646	0	0
Teta1 =	0	0	0	0.55933	0	0
Teta2 =	0	0	0	-0.0099663	0	0
Teta3 =	0	0	0	0.17362	0	0
Teta4 =	0	0	0	0.23544	0	0
Sigma =	0	0	0	0.47617	0	0
WavEnergySB(1)D1 =	nan	nan	nan	15.688801	nan	nan
WavEnergySB(1)D2 =	nan	nan	nan	27.305748	nan	nan
WavEnergySB(1)D3 =	nan	nan	nan	9.3000496	nan	nan
WavEnergySB(2)D1 =	nan	nan	nan	nan	nan	nan
WavEnergySB(2)D2 =	nan	nan	nan	nan	nan	nan
WavEnergySB(2)D3 =	nan	nan	nan	nan	nan	nan
WavEnergySB(3)D1 =	nan	nan	nan	nan	nan	nan
WavEnergySB(3)D2 =	nan	nan	nan	nan	nan	nan
WavEnergySB(3)D3 =	nan	nan	nan	nan	nan	nan
WavEnergySB(4)D1 =	nan	nan	nan	nan	nan	nan
WavEnergySB(4)D2 =	nan	nan	nan	nan	nan	nan

Mazda - options

Features | Maps | Wavelets

Wavelet bits/pixel:

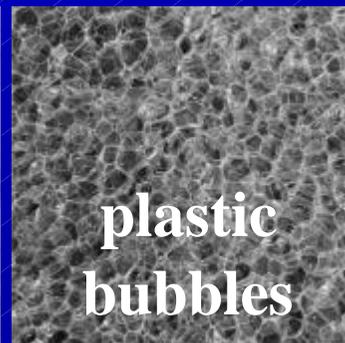
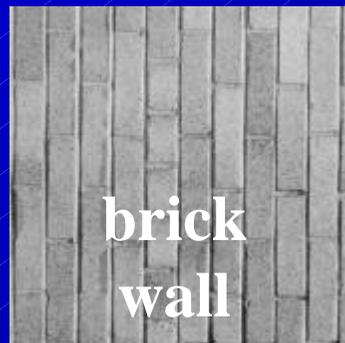
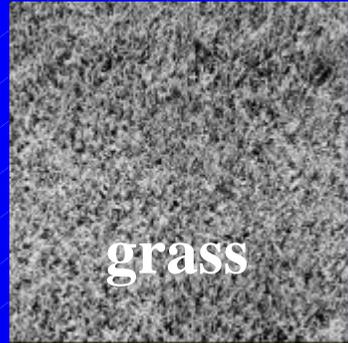
- 12
- 11
- 10
- 9
- 8
- 7
- 6
- 5
- 4

Wavelet features:

- Calculate Energy
- Calculate Moment
- Show Map

OK Cancel

Textures from Brodatz catalogue

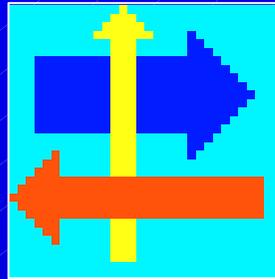


Methods



MaZda

**Vector of 15
wavelet features**



Convert

**10 features
with highest
F coefficients**



B 11

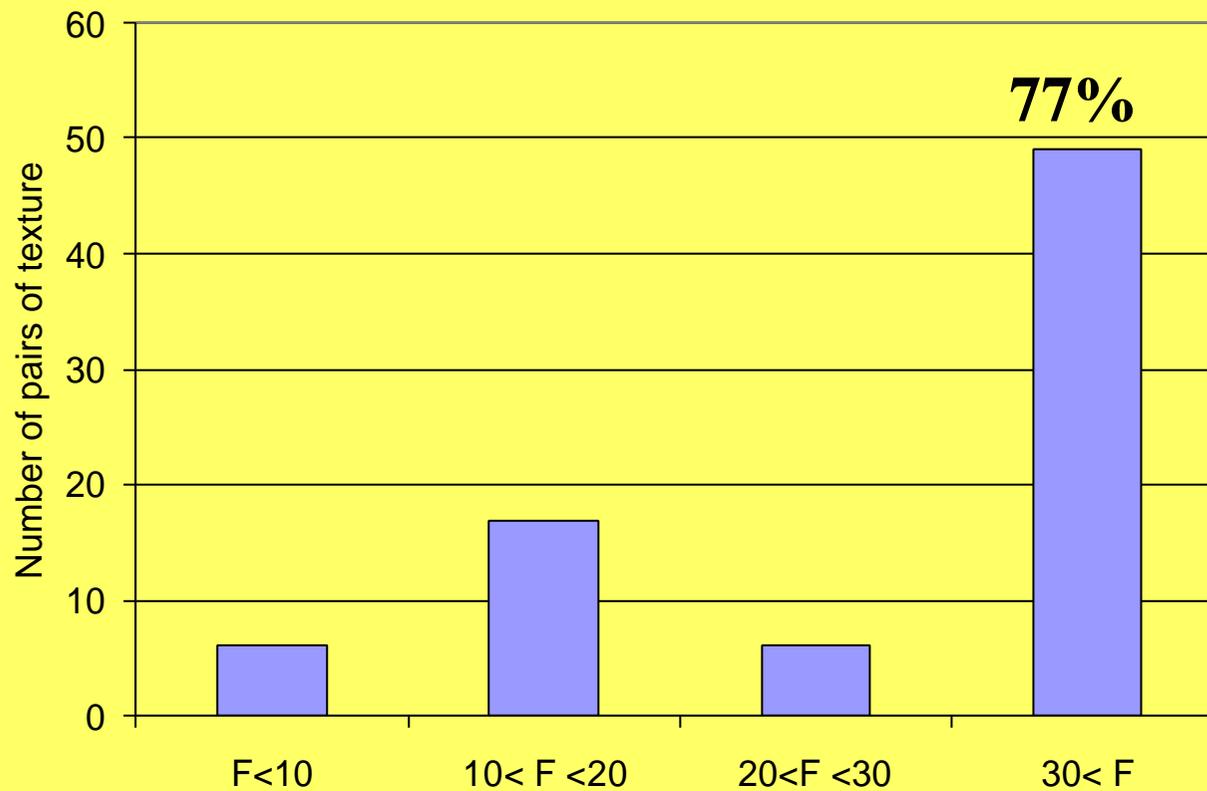
1-NN classifier

Effectiveness of classification for pairs of textures

bark	straw	herringbone weave	woolen cloth	calf	sand	water	wood	raffia	pig skin	brick wall	plastic bubbles	
	y	d	y	y	(2)						d	grass
										d	(2)	bark
		d	d	y	y						d	straw
					d							herringbone weave
					d							woolen cloth
												calf
											d	sand
							y		d			water
												wood
											d	raffia
												pig skin
											d	brick wall

- F coefficient < 5
- (2) -two misclassified samples
- one feature enough for 0 classification error
- d -two features required for 0 classification error
- y -more than two features required for 0 classification error

Effectiveness of classification for pairs of textures



Conclusions

- **Considered set of wavelet features is a powerful tool for texture separation.**
- **Most of examined pairs of textures can be separated by means of wavelet features with no classification error. A very small classification error (3%) was observed - for only two pairs of textures.**
- **Relatively small-sized vector of DWT features (1-2 elements) is sufficient for very good texture classification.**
- **Future work is planned in this area on applying this method to MRI images.**