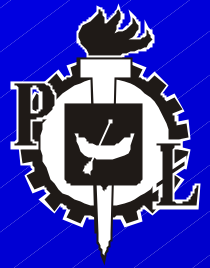
Politechnika Łódzka
Instytut Elektroniki



WAVELET MODULE FOR MAZDA

Marcin Kociolek

Plan of presentation

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

Discrete Wavelet Transform (DWT)

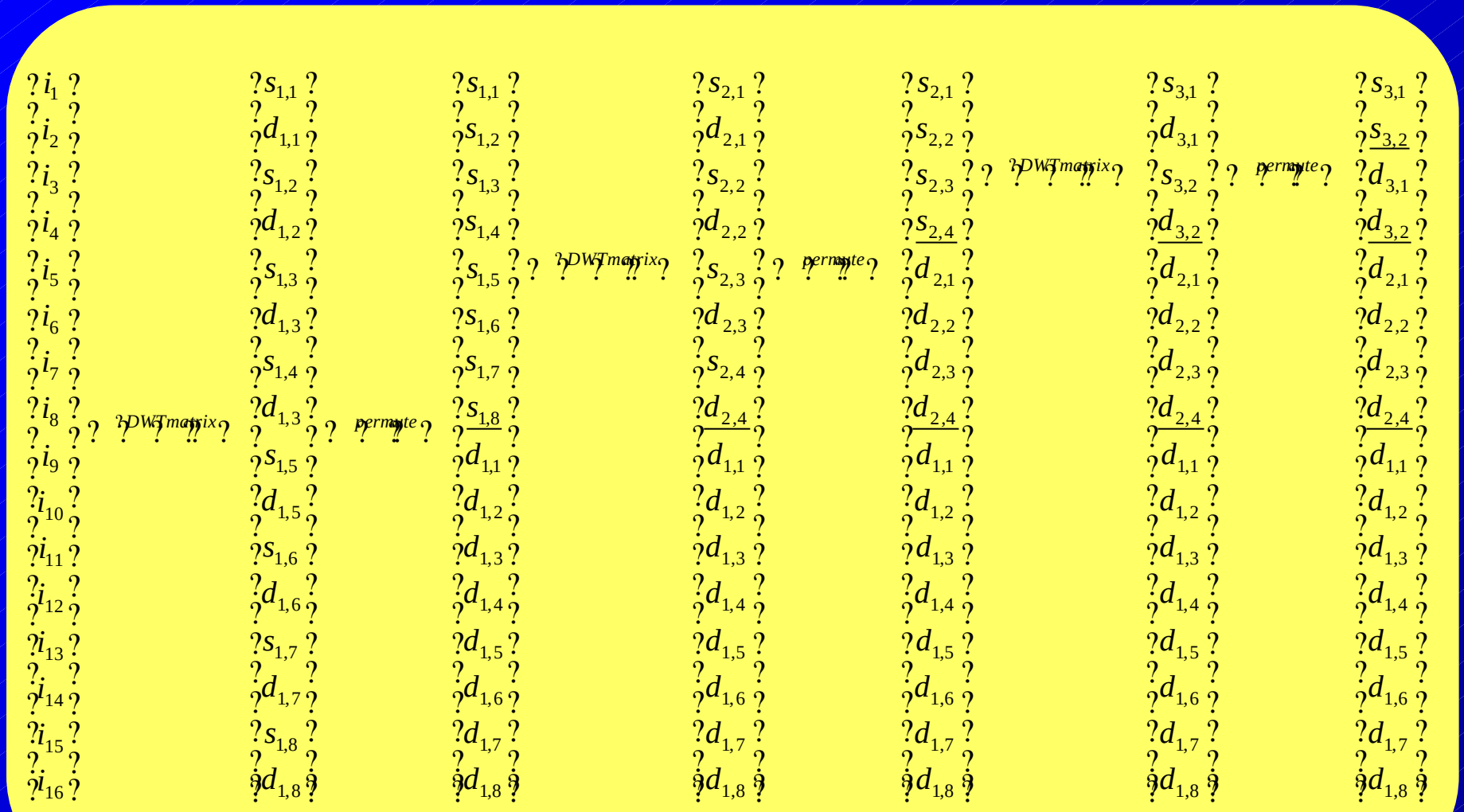
Wavelet transform equation

$$T^{wav} f(a,b) = \int f(t) \frac{t - b}{a} dt$$

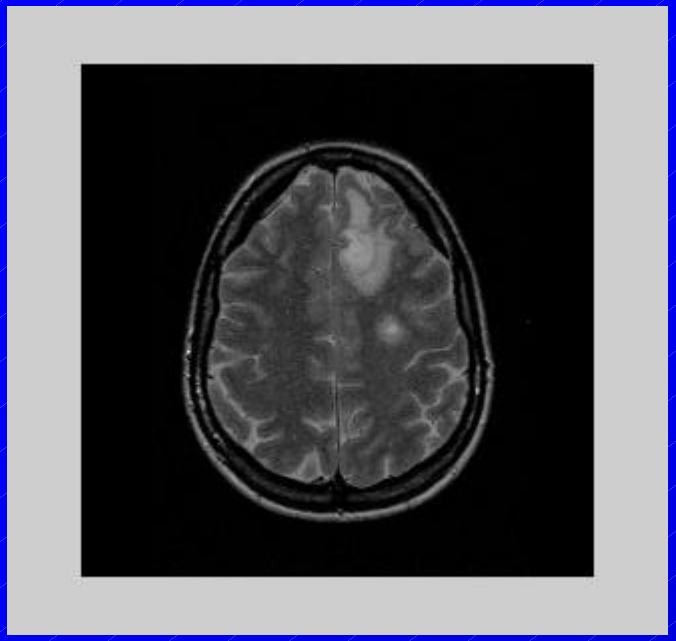
Discrete wavelet transform matrix

$$\begin{bmatrix} 0.5 & 0.5 & & & & & & \\ 0.5 & -0.5 & & & & & & \\ & & 0.5 & 0.5 & & & & \\ & & 0.5 & -0.5 & & & & \\ & & & & \ddots & & & \\ & & & & & & 0.5 & 0.5 \\ & & & & & & 0.5 & -0.5 \end{bmatrix}$$

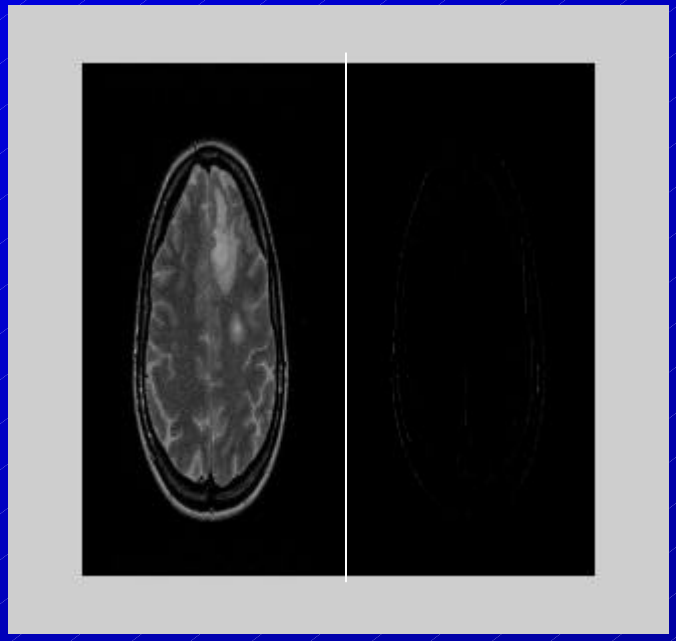
DWT pyramidal algorithm

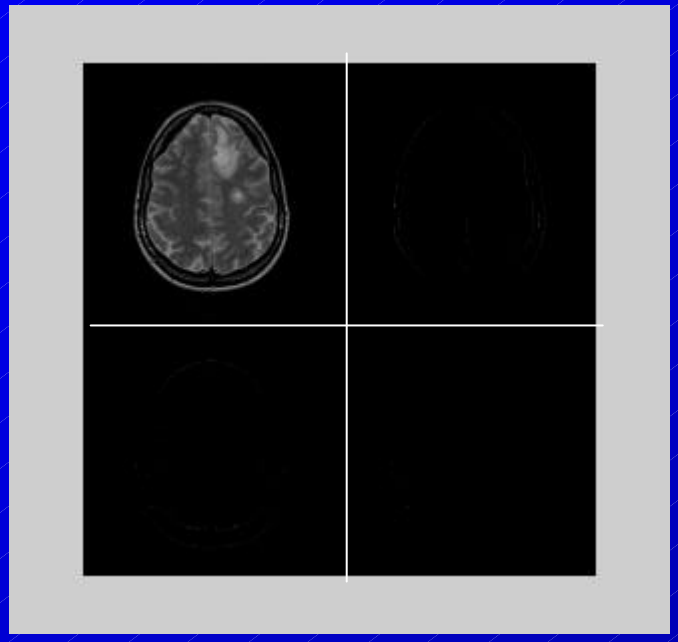


DWT on images



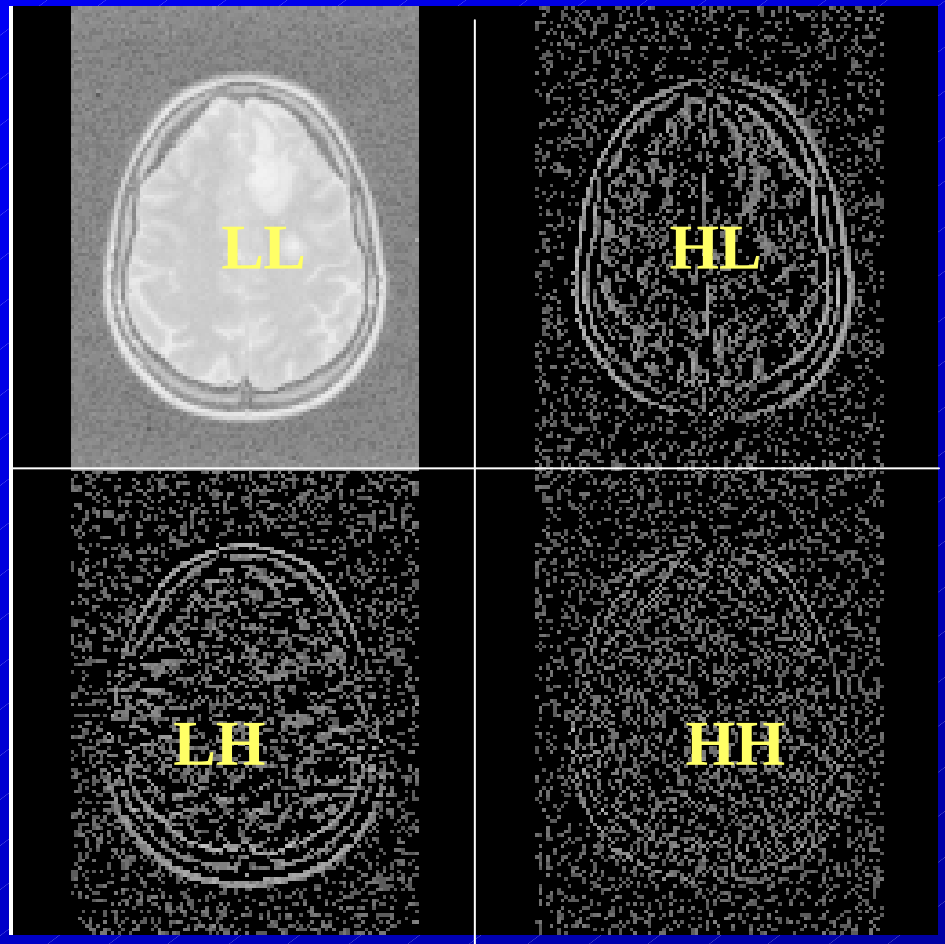
DWT
in rows





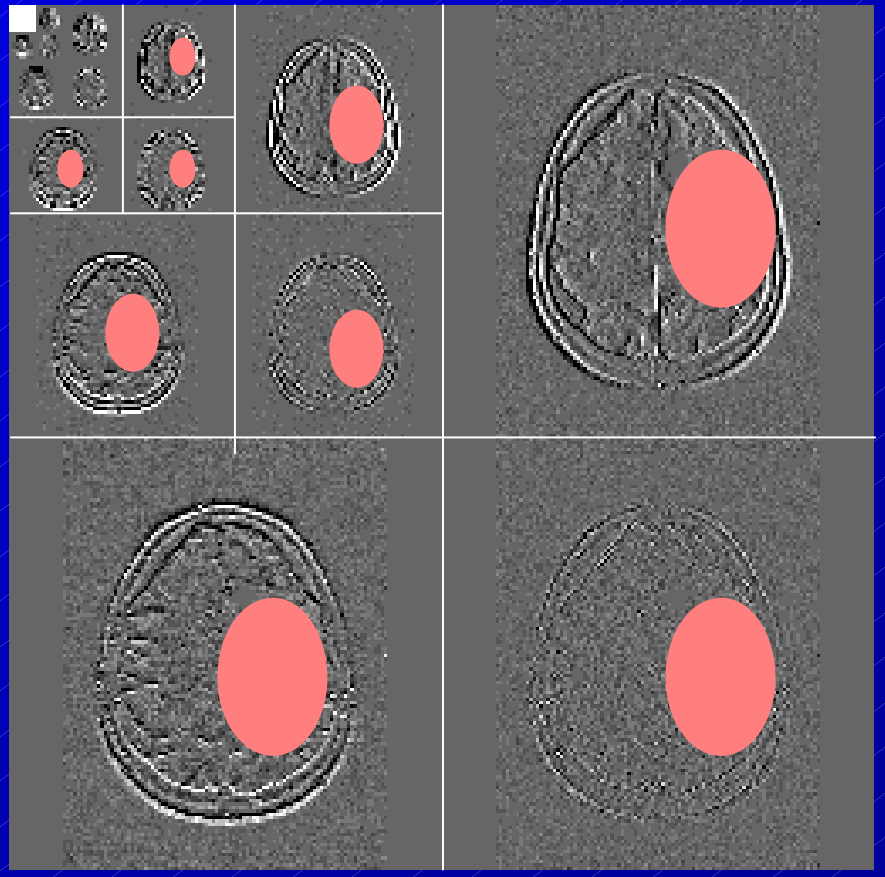
DWT
in columns

DWT on images

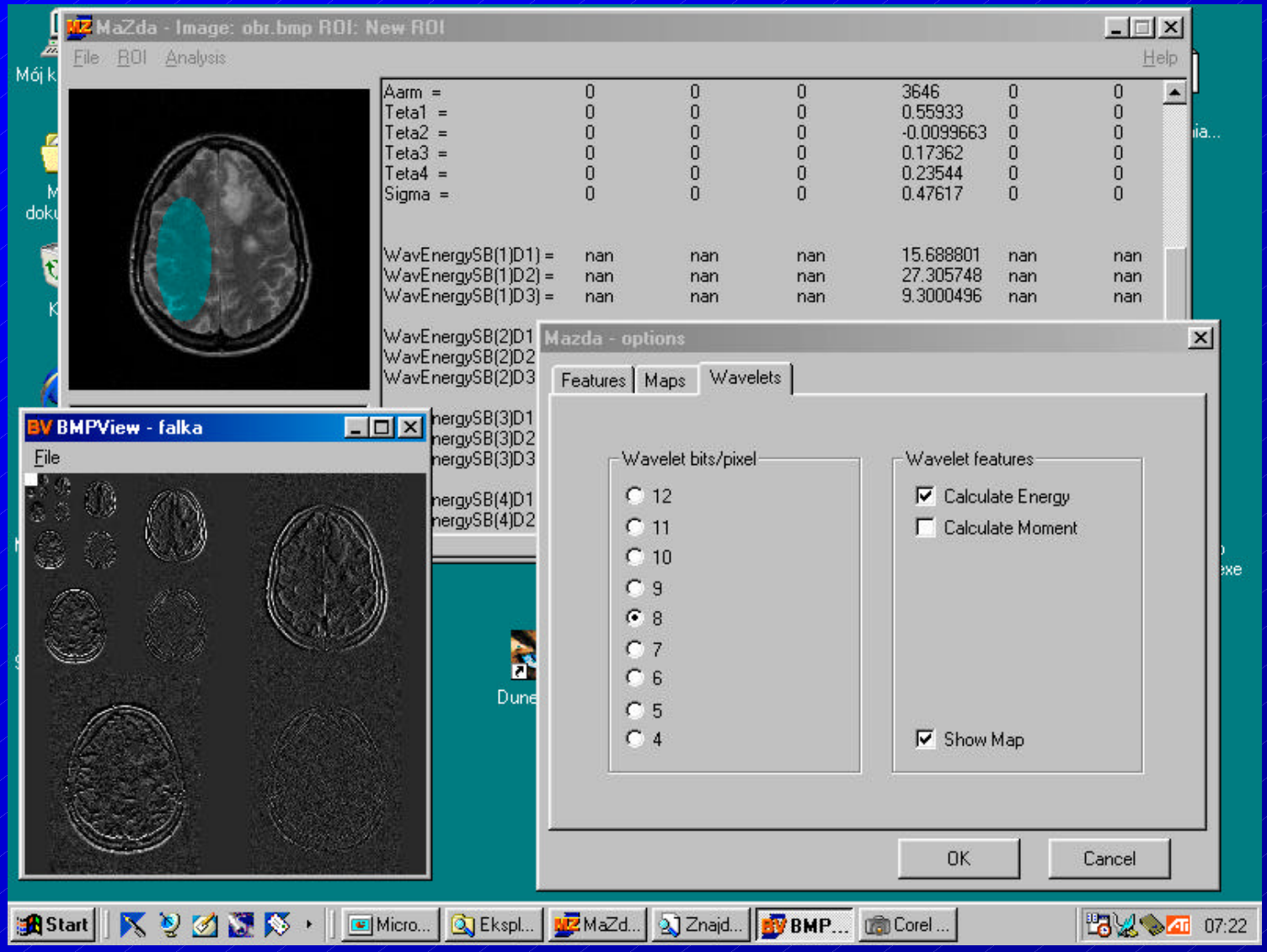


Wavelet texture features

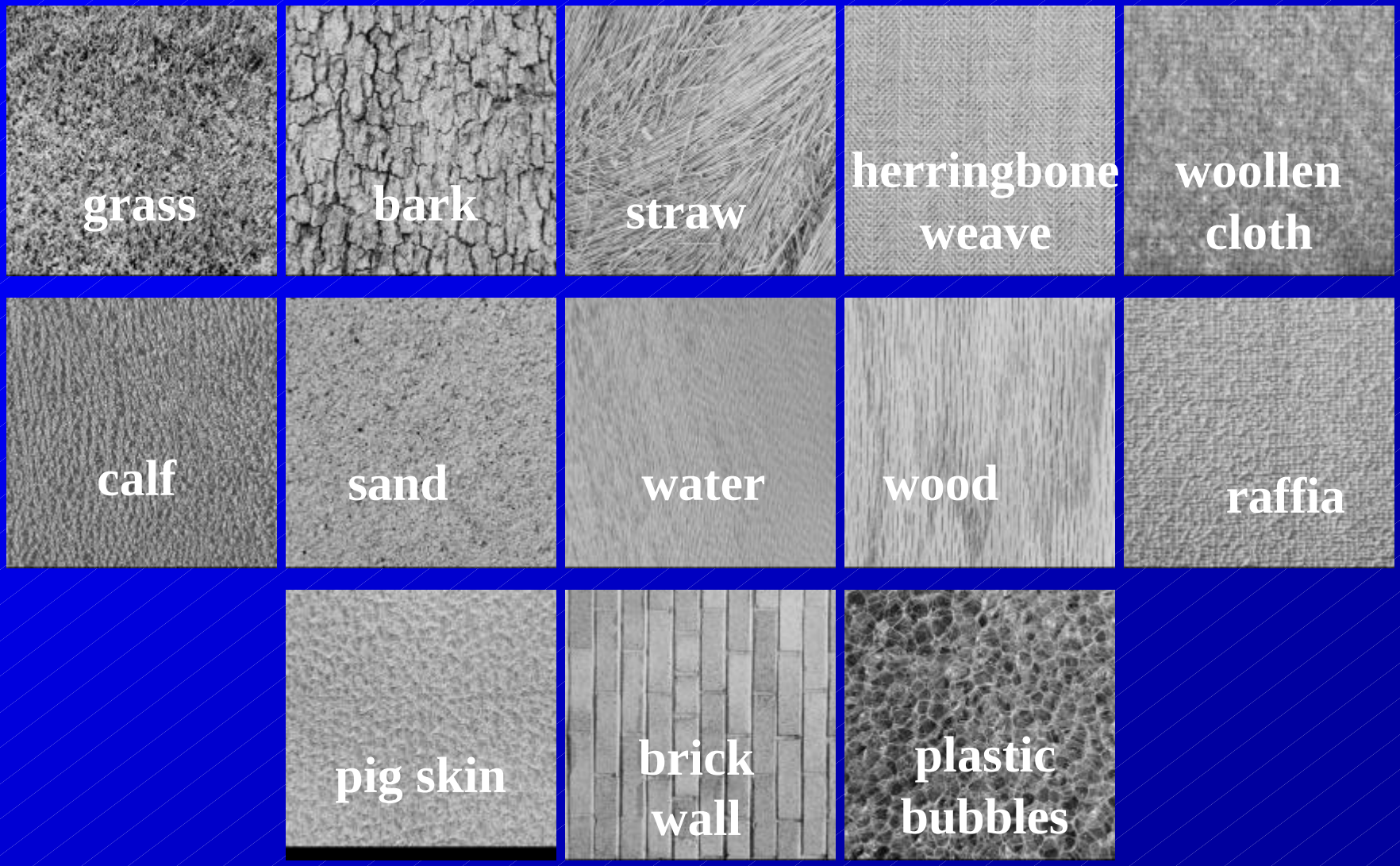
$$E_{subband,scale} = \frac{\sum_{x,y \in ROI} |i_{x,y}|^2}{n}$$



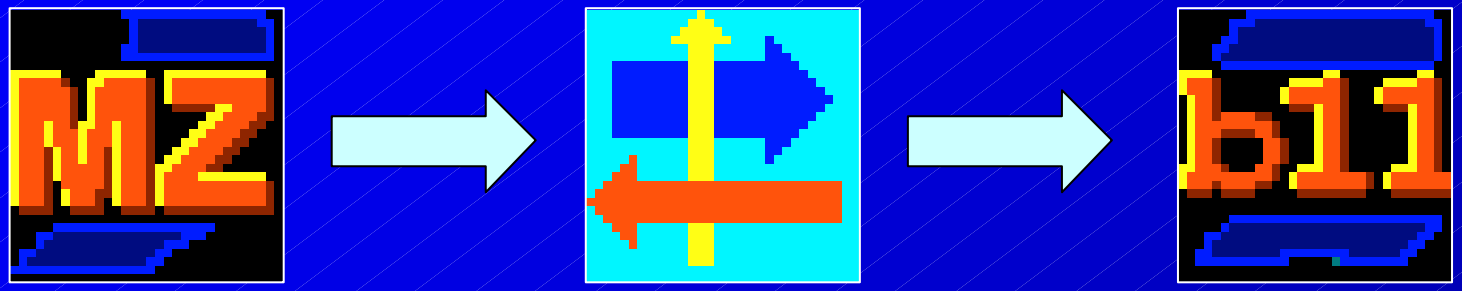
Wavelet MaZda module



Textures from Brodatz catalogue



Methods



MaZda

Convert

B 11

Vector of 15 wavelet features

10 features with highest F coefficients

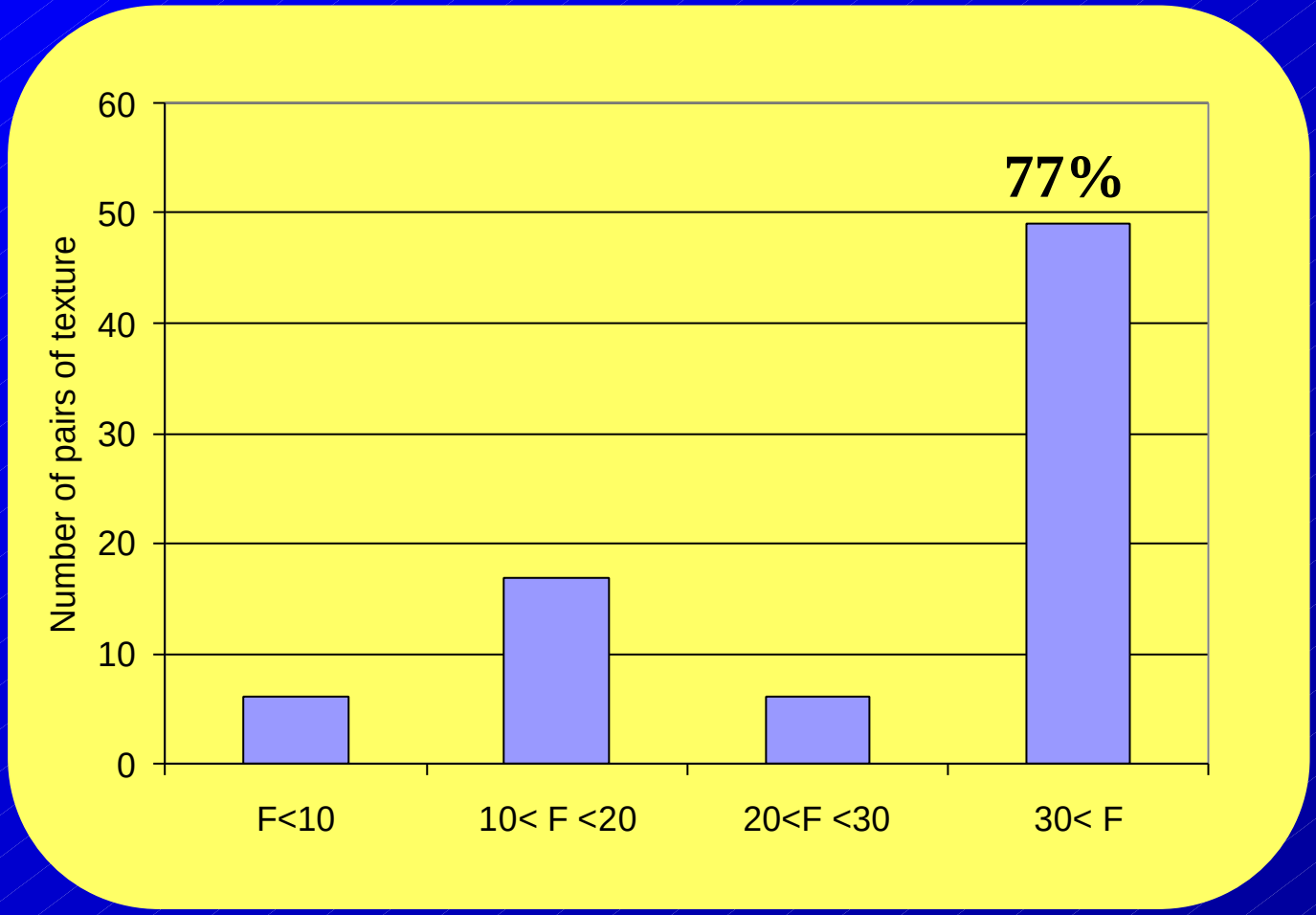
1-NN classifier

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 planed in this area on applying this method to MRI images.**