THz and IR molecular imaging of paraffin-embedded cancerous tissues

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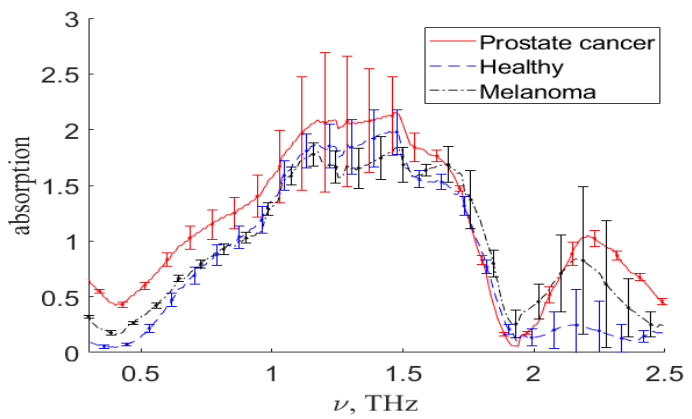
Abstract: The promising method for diagnosing pathological tissue changes at oncological diseases is the combination of THz spectroscopy and multiphoton imaging and machine learning. THz spectroscopy provides investigate dehydrated cancerous tissues. Multiphoton microscopy has great potential for visualizing a morphological structure of tissue samples. The aim of the report is a discussion of the ability of classification of cancerous tissue samples using THz and IR molecular imaging and machine learning.

Prostate cancer and melanoma paraffin-embedded tissues analysis

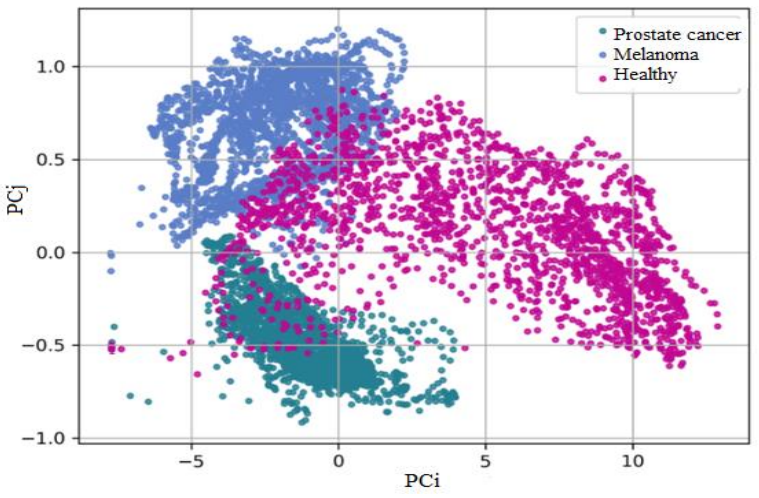
THz spectra of paraffin-embedded tissue samples



Binary “One”-Vs-”One” SVM classification

Classified groups	Sensitivity		Specificity	
	Mean	Dispersion	Mean	Dispersion
“Prostate cancer” vs “Healthy tissue”	0,92	0,001	0,92	0,001
“Melanoma tissue” vs “Prostate cancer”	0,99	0,001	0,97	0,001
“Healthy tissue” vs “Melanoma tissue”	0,99	0,001	0,99	0,001

Result of principal component analysis



Differential diagnosis based on the “One”-Vs-”One” SVM classifiers

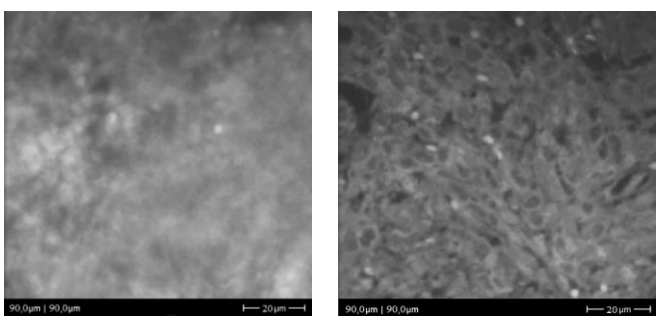
Classified group	Number of samples	Correct diagnosis, %	
		Standard approach	“Ensemble learning” classification
“Prostate cancer”	27	91	100
“Melanoma tissue”	20	93	100
“Healthy tissue”	43	95	100

Summary

Principal component analysis gives good enough spatial separation of prostate cancer, melanoma and healthy tissues. To provide multi-class classification was used a set of binary “one” Vs “one” SVM classifiers. Differential diagnosis based on the “ensemble” learning classification provides perfect results.

The possibility of applying optical cleaning to paraffin-embedded cancerous tissue to improve visualization of the internal tissue structure for diagnostic and research purposes is considered.

Multi-photon microscopy results



An example of a fluorescence image of a paraffin block with cancer tissue without an optical clearing agent and after glycerol

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