Spectroscopic imaging (SI) is the method which enables non-invasive studying of the metabolite composition of tissues *in vivo* from multiple regions simultaneously. The objective of this thesis was to develop a methodology for the reliable evaluation of *in vivo* SI data. The thesis addresses several aspects of the evaluation of SI data as described below.

The processing of SI data represents a complex issue requiring dedicated evaluation programs. Although various spectra processing programs are provided by the vendors of MR scanners, software enabling complete SI data processing and analysis is not available. The CULICH program has been developed within the framework of this thesis to enable the comprehensive processing of SI data. The program offers advanced functionality for evaluation of SI data. The initial experience with the program shows that CULICH is suitable for evaluation of SI data measured in both clinical practice and the experiments.

The accuracy of calculated concentrations is of high importance for each quantification method. SVS techniques can be taken as the gold standard for quantification of MR spectra. Therefore, to asses the accuracy of the metabolite concentrations measured by SI, the comparison of results obtained by SI and SVS was performed. The direct comparison of results obtained by SI and SVS techniques showed that in the experimental setup used there were no significant differences in concentrations calculated using both methods. Although principal issues, such as the existence of point spread function, make quantitative SI less reliable, the results suggests that quantification of spectra using the SI technique is possible.

Inhomogeneous radio frequency magnetic field (RF), is an essential source of error for the quantification of MRI and MR spectroscopy parameters. In order to correct for effects of RF inhomogeneities in 3D datasets knowledge of the 3D RF distribution in the sample is necessary**.** The sequence for 3D mapping of RF was proposed in the thesis and its use for the determination of the *VOI* profile in inhomogeneous RF was demonstrated. It was shown that inhomogeneous RF may play a significant role in determination of the excitation profiles. 3D RF mapping sequence may also find use in determining corrections for RF inhomogeneity related signal variations in structural and functional MR imaging.

For clinical practice, the interpretation of metabolite images rather than individual SI spectra is desirable. Therefore, the reliability of metabolite images is of high importance. To simplify the quality analysis of spectra measured by SI, an error image, reflecting the accuracy of the computed concentrations, can be displayed. The objective of this part of the thesis was testing the relevance of Cramer-Rao bounds (*CRBs*) estimated by LCModel as a potential parameter for the calculation of error images for estimated concentrations and the proposal of a new parameter for the calculation of error images for concentration ratios.
It was shown that *CRBs* are strongly correlated with the standard deviations of the calculated concentrations and therefore reflect the relative uncertainty of the calculated concentrations among voxels in the spectroscopic grid, which makes *CRBs* a suitable parameter for the calculation of error images in SI. This approach avoids extensive examination of each spectrum of large SI data sets and helps to reject low quality spectra

The last part of the thesis focuses on the use of the developed processing program in clinical application. The developed methodology was used for the evaluation of SI data measured in patients with MRI-negative extratemporal focal epilepsy. The result suggests that the SI technique may provide important additional data in the presurgical evaluation of patients without apparent MRI lesions. The most

important message of the study is the good correlation among 1H MRS, ictal SPECT and subdural mapping, which was subsequently confirmed by histopathological analysis of the resected tissue.

It can be concluded that the developed methodology will contribute to the more accurate evaluation of SI data, which improves the reliability of clinical examinations using SI techniques.