Summary

Natural or man-made cavities in the ground are potential sources of slow subsidence as well as for sudden falls. Examples can be found in abandoned mining, in areas of karst formation or underground constructions. Sudden falls especially can cause a high risk for people and infrastructure. A detection of these dangers by potential slow deformation in advance can help to avoid more disastrous effects on the environment.
For this reason in this thesis the method of Differential Radar Interferometry (DInSAR) is evaluated concerning its capabilities for the detection of surface movements with small extents and slow movement rates. The detection limits of the method are determined first by using synthetic ground movement scenarios and data from sensors ERS-1/2. Post-processing techniques based on statistics and spectral pattern recognition are developed and applied to improve the detection limits.
By using a single interferogram the detection limit can be set to anomalies with horizontal extents of around 800 m in the case of vertical movements exceeding 10 millimetres. Anomalies with smaller extents proved to be not detectable. This result can be improved by using multiple interferograms and different post-processing techniques. Strong improvements can be achieved by using methods based on statistical approaches. One technique is the new “coherence based weighted mean technique”. Main idea of this technique is the determination of weights from coherence estimations, which can be calculated by using SAR parameters. These weights can be used for calculating a weighted mean. Alternatives are spectral pattern recognition methods transferred from optical remote sensing. As an unsupervised classification technique, the „Iterative Self-Organizing Data Analysis -Technique“ based on the K-Means approach has been used. In addition, good classification results have been possible by using the “Minimum Spectral Distance” method as a supervised classification technique. By the application of these post-processing techniques the detection limits have been improved in the best case to surface movement anomalies with horizontal extents down to 400 m in the case of movement rates exceeding 10 millimeters/year.
The synthetically found detection limits have been confirmed by field examples with subsidence due to subway construction and changes in mine water level in an abandoned mine. Some more verifications are also presented from literature.
Finally by using a real field application in context with the detection of abandoned mining induced surface movements, it is shown, how additional geographical information can be used within a Geographic Information System to classify DInSAR results regarding the potential sources of surface movements. This approach can be used to focus further analysis and to check quality of DInSAR detection results.
The new post-processing techniques in combination with a classification of the detection results by using additional geoinformation proved to be a good approach to detect surface movements of small extents and low movement rates.