

DINSAR Detection of Residual Settlement of Land Reclaimed From The Sea in Newly Developed Lingang New City, Shanghai, China

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In order to satisfy a great land demand for industrial development, business and coastal engineering, man-made lands reclaimed from the sea are used to build airports, harbours, and industry parks using its broad air and land spaces. However, reclaimed foundation settlement process is of public concern, including the continuous impacts of ocean processes on its stability. Ground subsidence with a rate of 10 cma-1 may cause serious damage to buildings, highways, airport runways, harbours, and underground facilities. Thus, detection and measurement of residual settlement of reclaimed land, including monitoring continuous impacts of ocean processes on its stability, are a necessary work.

Lingang New City has been the biggest development plan for Shanghai since Pudong New Area. The area of Lingang New City is approximately 300 km². The area, where Lingang New City is built, is reclaimed from the sea. The goal of the proposed project is to investigate residual settlement of the reclaimed foundation, coastal line change, and erosion assessment at Lingang New City with high resolution SARs. In this project, higher level products, such as ground settlement history at each Persistent Scatterer (PS) point, ground settlement trend map, coastal lines change map, and coastal erosion rates will be obtained by exploiting archives of SAR data collected by the ERS-1/2, ENVISAT, Sentinel-1, ALOS, TerraSAR-X, and TanDEM-X radar sensors and Persistent Scatterer Interferometry (PSI) methodologies, including the Small Baseline Subset (SBAS) approach and Differential Interferometric Synthetic Aperture Radar (DInSAR) technologies. The achieved results will be validated by inter-comparison to available ground truth data. Ground settlement models of reclaimed foundation of the study area will be derived. To the purpose, time series analyses, correlation analyses, and statistical analyses will jointly be performed. Based on the retrieved ground deformation velocity maps of the study area, a thematic map of the subsiding zones will finally be generated. For this project, we will further study the relationship of continuous impacts of ocean processes and ocean reclamation foundation stability with long time series of high resolution SAR images. In addition, long-term deformation time series obtained by processing high resolution SAR images will also be used to monitor coastal line change and erosion assessment at Lingang New City. Coastal line change map and coastal erosion rates will be retrieved through an integrated multi-sensor DInSAR analysis. The scientific work will be financed from internal resources of the participants. The deliverables of this proposal are papers and reports relevant in particular to the monitoring of coastal zones. Additional funding will also be applied from National Natural Science Foundation of China, and the China-Italy governmental cooperation in the framework of the science and technology program.

上海临港新城填海地基形变DInSAR监测研究

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为满足工业发展、商业和海岸带大型工程对土地的巨大需求，填海造陆是解决土地资源短缺的途径之一。填海造陆区域通常地势平坦、开阔，常用于建造机场、港口和工业园区。然而，填海造陆地基长时间缓慢形变过程，特别是海洋过程对海岸带填海工程的持续影响，将会影响建设在填海地基上建筑物的稳定性和地下埋设的城市生命线的安全，也是公众关注的问题。如果地表形变速率达到10 cm/y，就可能会对地表建筑物、高速公路、机场跑道、港口以及地下设施造成严重的损坏。因此，探测和测量填海造陆区域地表形变，包括监测持续的海洋过程对其稳定性的影响，是尤为重要的。

上海临港新城是自开发浦东新区以来上海市最大的发展计划。上海临港新城总面积约300 km²，填海地基占到总面积的45%。本项目旨在采用多源卫星合成孔径雷达高分辨率影像监测临港新城填海造陆区域的地表形变、海岸线变化及侵蚀评估，解译海洋动力过程对填海区地基稳定性的影响作用。本项目将利用多源卫星合成孔径雷达影像长时间序列（包括ERS-1/2, ENVISAT, Sentinel-1, ALOS, TerraSAR-X, TanDEM-X），采用永久散射体干涉测量（Persistent Scatterer Interferometry, PSI）、小基线集（Small Baseline Subset, SBAS）方法和合成孔径雷达差分干涉测量（Differential Interferometric Synthetic Aperture Radar, DInSAR），获取研究区永久散射体点/ SDFP点（slow decorrelating filtered phase）的地表形变时间序列、地表形变趋势图、海岸线变化图和海岸带侵蚀速率等。将永久散射体雷达干涉测量技术方法和小基线集方法得到的形变监测结果，分别与地面水准测量监测的近同步测量结果进行验证分析，进一步将不同方法之间的结果对比分析，进行交叉验证。综合利用时间序列分析，相关分析，统计分析，及主题制图方法分析填海区地表形变的变化规律，并建立填海地基形变经验解析模型。分析解译上海临港新城海岸带填海区地表形变场的分布规律、形变规律及地基形变经验解析模型。采用统计分析法定义填海区地表形变稳定区和持续形变区，进一步使用主题制图法绘制填海区稳定区范围和持续形变区范围。另外，本项目还将结合多源卫星合成孔径雷达高分辨率影像得到的地表形变长时间序列结果监测分析海岸线变化和侵蚀评估，通过多源卫星合成孔径雷达高分辨率影像DInSAR分析，获取海岸线变化图和海岸带侵蚀速率。采用主题制图法和统计分析方法，结合填海区地表形变场分布规律和海岸带动态变化，分析海洋动力过程对填海区的作用。