2573293

Land Use / Land Cover mapping for urban changing monitoring

Lisini, Gianni; Aldrighi, Massimiliano; Gamba, Paolo
University of Pavia

The classification of urban areas in terms of Land Use/Land Cover (LULC) maps is a challenging as well as essential task in order to monitor how the urban sprawl is changing the environment. Methodologies for human settlements extraction and characterization in terms of land use/land cover (LULC) from SAR data are based on the spatial properties of this environment. Moreover, many works proposed in literature (see [1] for example) show that no single-pixel measure may be suitable alone for these tasks, and spatial analysis is required. As a consequence, local as well as global spatial features have been considered as a valid tool for human settlement mapping and the followed approaches differed in the nature of the features and the complexity of the features fusion approach ([2], [3], [4]). The basic idea beyond this work is the elaboration of a novel procedure able to process SAR data in order to provide, at the same time, both the urban area extents and the classification of those areas in terms of LU/LC maps. Moreover, the conceived approach needs a limited number of features and no extensive tests. The LU/LC classification represents the real novel phase of the procedure and starts from the urban area extents output map provided by the BuiltArea [5] algorithm, applying a classification scheme based on the same features exploited for urban extents extraction, together with three new indexes: the local speckle divergence, the linear features density and another density index produced by the BuiltArea algorithm during its elaboration. The entire procedure may be represented by ten ideal steps subdivided in five different macro-areas, spanning from the urban extents extraction procedure to the LU/LC map generation. The first step consists in the human settlements extents extraction, and, as aforementioned, for this we rely on an advanced version of BuiltArea. The following step, which may be performed also in parallel, is a segmentation into homogeneous areas, implemented by a chain which includes a despeckle filter and the actual segmentation procedure. Training and test area selection is then performed, based on available ancillary data sets or on manual interpretation of VHR optical images. The very new idea of this work is the way regions are employed instead of relying on single pixels values in the final LU/LC classification and it is based on the fact that urban environments tend to show a natural structural organization, and they can be seen as block agglomerates rather than building units. This is especially true in HR images, where spatial resolution tends to highlight the natural disposition of groups of buildings instead of a singular building detail, and this is verifiable at SAR data with a spatial resolution around 10m as well. Accordingly, it makes sense to segment a SAR image into statistically homogeneous areas and use these regions as a spatial proxy to urban blocks. This operation can be seen as a clustering process in which each object may be eventually labelled as part of a specific urban land cover class, according to specific criteria. Hopefully, if the segmentation is man- aged in order to "over-segment" a real urban block, the segments may be "re-assembled" into meaningful spatial landscape elements via the spatial features selected according to the previous section. One data set used to test the procedure consisted in an ENVISAT/ASAR image acquired on Shanghai in August 2nd, 2008, an Alternate Polarization mode Precision image (APP) with a spatial resolution of 12.5 meters. Results, demonstrate, at least at a preliminary stage, how the joint use of SAR (for the preliminary classification) and optical images (for the segmentation phase) may lead to an overall better classification by as much as 6% and 0.07 in the K coefficient. All the different classes are better recognize in terms of producer and user accuracy, and especially the commercial areas increased by as much as 5% in the producer accuracy. [1] F. Dell'Acqua, M. Stasolla, and P. Gamba, “Unstructured human settlement mapping with SAR sensors”, Proceedings of IGARSS06, 30 July-4 August 2006, Denver, CO, pp. 3619-3622. [2] M. Stasolla and P. Gamba, “Semi-automated extraction of human settlements extents in HR SAR images,” Proceedings of IGARSS08, 6-8 July 2008, Boston, MA, vol. V, pp. 168-171. [3] J. Carr and F. de Miranda, “The semivariogram in comparison to the co-occurrence matrix for classification of image texture,” IEEE Transactions on Geoscience and Remote Sensing, vol. 36, no. 6, pp. 1945-1952, 1998. [4] P. J. Curran, “The semivariogram in remote sensing: An introduction,” Remote Sensing of Environment, vol. 24, pp. 493-507, 1988. [5] P. Gamba and M. Stasolla, “Spatial indexes for the extraction of formal and informal human settlements from high resolution SAR images,” IEEE Journal on Selected Topics in Applied Earth Observation and Remote Sensing, vol. 1, no. 2, pp. 98-106, June 2008.

Dragon project id
04 URBANISATION (ID. 5317)

城市变化监测的土地利用/土地覆盖制图

Lisini, Gianni；Aldrighi, Massimiliano；Gamba, Paolo

意大利帕维亚大学

通过土地利用/土地覆盖制图进行城市区域分类，是监测城市扩展对环境改变的一个挑战和重要的任务。从雷达数据提取人类居住地、并确定土地利用/土地覆盖特性的方法主要是基于环境的空间属性。文献指出（如[1]）没有一种单像素度量适用于所有任务，空间分析总是必须的。因此，局部和全局的空间特征已经作为一种有效的人类居住区制图的手段，而且当前一些方法在特征性质和特征融合复杂性上各不相同（[2],[3],[4]）。本项研究最基本的思想是详细阐述一个全新的处理雷达数据的过程，并提供城市区域扩展和用土地覆盖/利用图来展现区域分类。此外，该方法仅需要一定数量的特征，不需要大量的测试。土地覆盖/利用分类代表了该过程一个全新的阶段，从由建成区算法[5]提供的城市区域范围的输出图开始，应用一个代表城市范围提取的某些特征的分类策略，同时考虑了三种新的指标：局部图斑散度、线性特征密度和其他任一种由建成区算法得到的密度指标。整个过程可以通过十个细分至五种不同宏观区域的步骤表示，从从城市范围提取开始，直至土地利用/覆盖图制作。第一步包括居民地范围提取，如上述所说，使用最新版本的BuiltArea算法。接下来也可以同时执行的步骤是图像分割得到同质区域，通过一连串的斑点滤除和实际分割过程实现。随后，根据可用的辅助数据集或者对于VHR光学影像的人工解译，选取训练和测试区域。本项研究一个非常重要的创新是在最终土地利用/覆盖分类中，通过区域分析代替传统意义上的基于单像素，并且立足于城市环境趋势以显示出自然结构组织的基础，将其视为街区聚集区而不是建筑物单元。这与高分辨率影像实际相符，因为空间分辨率将以强调自然的建筑物组合来替代单一的建筑物细节，这也在10米空间分辨率的雷达数据上得到了证实。因此，将雷达影像分割至统计上同质的区域对象并且使用他们作为城市街区的空间代表合乎常理。这项操作可以被视为是聚类过程，在此过程中每个对象会根据某种准则，最终标记为一个特定城市土地覆盖类别的一部分。假如分割是托管的以"过度分割"真实的城市单元，则分割可能会通过前一部分被选择的空间属性"重新集成"至更有意义的空间景观因子。利用上海市2008年8月2日的ENVISAT/ASAR双极化模式的高精度图像（APP）测试该方法，影像空间分辨率为12.5米。试验结果表明，联合使用雷达（初步分类）和光学影像（分割阶段）可以提高分类的总体精度6%，kappa系数提高0.07。根据生产者精度和用户精度来看，所有不同的类别被更好地识别，特别是商业区其生产者分类精度最高可提高5%。

参考文献：

[1] F. Dell'Acqua, M. Stasolla, and P. Gamba, "Unstructured human settlement mapping with SAR sensors", Proceedings of IGARSS06, 30 July-4 August 2006, Denver, CO, pp. 3619-3622.

[2] M. Stasolla and P. Gamba, "Semi-automated extraction of human settlements extents in HR SAR images, " Proceedings of IGARSS08, 6-8 July 2008, Boston, MA, vol. V, pp. 168-171.

[3] J. Carr and F. de Miranda, "The semivariogram in comparison to the co-occurrence matrix for classification of image texture," IEEE Transactions on Geoscience and Remote Sensing, vol. 36, no. 6, pp. 1945-1952, 1998.

[4] P. J. Curran, "The semivariogram in remote sensing: An introduction," Remote Sensing of Environment, vol. 24, pp. 493-507, 1988.

[5] P. Gamba and M. Stasolla, "Spatial indexes for the extraction of formal and informal human settlements from high resolution SAR images," IEEE Journal on Selected Topics in Applied Earth Observation and Remote Sensing, vol. 1, no. 2, pp. 98-106, June 2008.

龙计划ID：URBANISATION (ID.5317)