A Multi-Temporal Polarization SAR Classification Method Based on Time-Variant Scattering Features

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The multi-temporal polarimetric SAR data provides the difference of scattering characteristics in time dimension for scene observation, hence it could reflect the time-variant characteristics of the same scene. Based on this advantage, classification is one of the important applications of multi-temporal polarimetric SAR data. However, the features of time and polarization dimension used for classification basically are from the data at each certain time, which lack the interpretation of the scattering variant characteristics between multi-temporal data. To solve the problem, based on the specific data representation models for multi temporal polarimetric SAR data, this paper extracts new time-variant scattering features, including the change type as well as the change direction of scattering, which the previous static temporal/polarimetric features cannot provide.

Time series Radarsat-2 data is used for experiments. It includes 8 Fully PolSAR images from April 14,2009 to September 29,2009. The data interval of each scene is 24 days. The image size is 5300*3100 pixels. It contains 22 categories. Based on the difference model $T_m=T_i-r_mT_j$ (T_i,T_j are polarization coherence matrices of two times polarimetric SAR data, and r_m is the smallest eigenvalue of $T_i^{-1}T_j$, it can make sure that T_m is always a positive semidefinite Hermitian matrix), we extract a series of time-variant scattering features, using the components of H/A/α decomposition and Freeman decomposition to classify. Through analysis the classification results of transformer classifier, compared with traditional static features, using the proposed time-variant scattering features to classify can effectively improve the classification accuracy.

基于时变散射特征的时序极化 SAR 分类方法

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时序极化 SAR 数据能够为场景观测提供时间维度上的散射特征差异，可以反应同一场景的时变特征。基于这一优势，分类应用是时序极化 SAR 数据的重要应用之一。然而，目前用于分类的时间和极化维度特征基本来自于每一特定时相的数据，缺少对时序数据不同时相间散射变化量的解释。为了解决这一问题，本文基于时序极化 SAR 数据的具体数据表征模型提取了时变散射特征，它能够反应散射的变化类型及变化方向，这是以往静态的时间/极化特征所做不到的。

实验数据为 Radarsat-2 时间序列数据，它包含从 2009 年 4 月 14 日到 2009 年 9 月 29 日的 8 个时相的全极化 SAR 数据。数据时间间隔为 24 天，数据大小为 5300*3100，共包含 22 个农作物类别。基于差分模型 $T_m=T_i-r_mT_j$（T_i，T_j是极化 SAR 数据两个时相的极化相干矩阵，r_m是 $T_i^{-1}T_j$的最小特征值，它能够保证 T_m始终是半正定的 Hermitian 矩阵），我们提取了一系列时变散射特征，用其中的 H/A/α 和 Freeman 分解分量进行分类。通过对 transformer 分类器的分类结果进行分析，与传统静态特征相比，利用所提取的时变散射特征进行分类，可以有效地提高分类精度。