Hyperspectral image segmentation using adiabatic quantum computation

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Supervised machine learning techniques are widely used for classification of pixels in hyperspectral images. A typical simple classification scheme of such images assigns a probability distribution over a set of labels to each individual pixel. This assignment is achieved by using a two class classifier such as for example Support Vector Machine o k-nearest neighbours algorithm. When more than two labels are present a number of two-calls classifiers can be combined into a multi-class scheme.

Pixel classification usually omits information about pixel surroundings. In order to use information about the pixel surrounding and, hopefully achieve better classification results for real images, one has to consider the local label obtained from a classifier with the classes of pixel neighbourhood. One way to achieve this goal is to use Ising models.

In this class of models the class probability is mapped to spin energy and class-class interaction is mapped to the spins coupling. By finding low energy states of a Ising model we can find good classification assignments.

Finding a low-energy states of a Ising model can be done using quantum adiabatic computers. Yet there exists several challenges that are due the physical limitations of adiabatic quantum computers. Those challenges include:

- the need to map multi-class problems to two-class problems, due to the use of qubits;
- limited number of qubits available in current quantum annealers.

We show how to overcome, at least partially, these limitations and how to apply quantum annealers for hyper-spectral image classification.

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