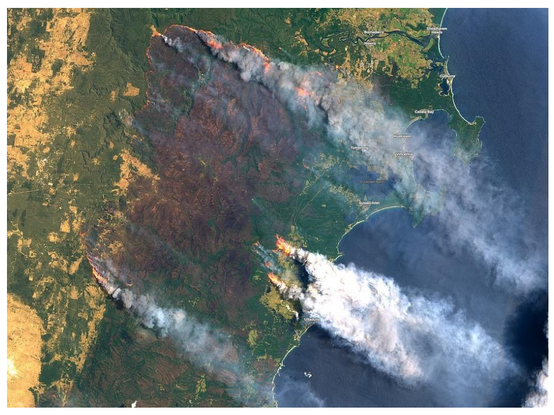
Content Based Image Retrieval In Large Earth Observation Image Archives

Earth Observation monitors the state and processes of the planet's ecosystem by retrieving information from multispectral satellite images. This technic can be used to monitor weather phenomenons, to improve agricultural processes or to detect natural disasters early. In recent years, earth observation missions led to rapid growth of earth observation image archives.

Agricultural Monitoring © ESA



Australien Wildfires © ESA

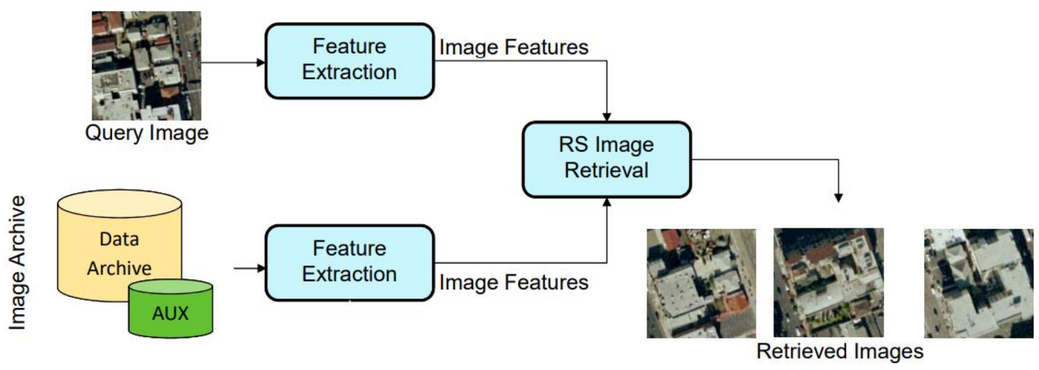
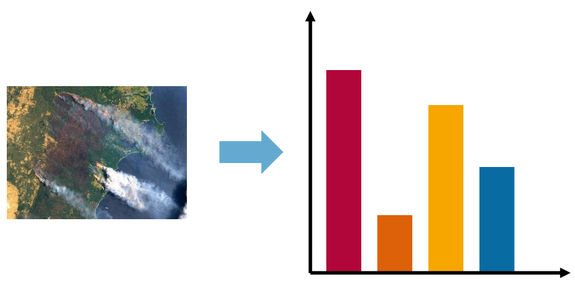


Image Retrieval aims at exploring relevant information from huge image archives. To discover information from large image archives, images can be queried by example. This can be either used to retrieve images with similar semantic content (e.g.: for detecting wildfires), or to retrieve tuples of images with a similar temporal changing content (e.g.: for monitoring deforestation).

Image Descriptors represent the semantic content

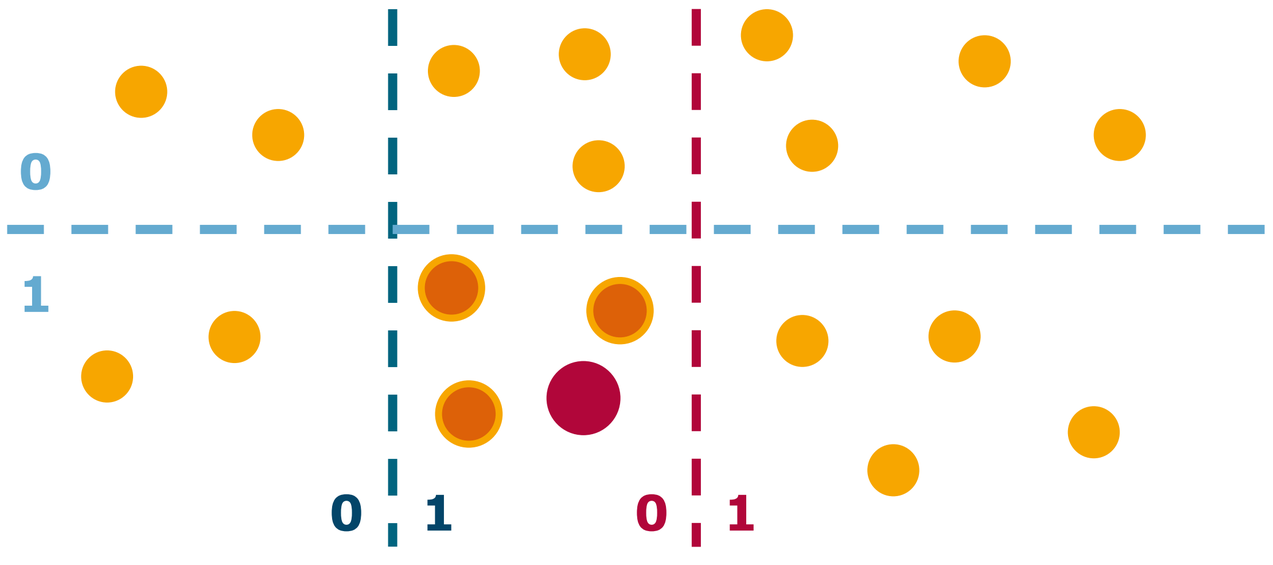


possible hand-crafted descriptors:

- Histogram-based features
- Scale-invariant Feature Transform
- Local Binary Patterns
- Region Based Descriptors

A Basic Approach is matching the images by using the k-Nearest-Neighbor algorithm. This way, all archive images need to be scanned to receive a range of similar images ordered by similarity to the query image. With a search complexity of $O(n)$, this is too slow for large archives.

Hashing Based Methods index the images of the archive based on their content. An approach to retrieve a hash from a set of image features is locality sensitive hashing (LSH). LSH quantizes projections of data with a few bits. To retrieve the r-th bit of the hash, the r-th hash function defines a hyper-plane, dividing the hyper-space with the image data into segments. A kernel-based approach can be used, to significantly improve the quality of the results.



Multi-Code Hashing can further improve image matching quality. Instead of calculating a large hash from global image descriptors to index an image, images are characterized by descriptors of semantic primitives. Those descriptors are transformed into multiple hash codes which are assigned to the image as multi-hash.

Method		Recall	Time (in seconds)	Storage Complexity
Unsupervised	k-nn	66.29 %	128×10^{-4}	1.640 KB
	single-code hashing	58.74 %	62.7×10^{-4}	0.033 KB
	multi-code hashing	**65.29 %**	62.7×10^{-4}	0.068 KB
Supervised	ML-SVM	71.93 %	21139×10^{-4}	1.640 KB
	single-code hashing	59.20 %	62.7×10^{-4}	0.053 KB
	multi-code hashing	**69.05 %**	62.7×10^{-4}	0.068 KB

Antonius Naumann, *Bachelor Student*
Hasso Plattner Institute, Potsdam, Germany

This poster is based on the lecture "Deep Earth Query - Advances in Remote Sensing Image Characterization and Indexing from Massive Archives" by Prof. Dr. Begüm Demir which is part of the lecture series "Practical Data Engineering (WT 2019/20)"

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