**Satellite Image Automatic Mapper™ (SIAM™) - A first-stage preliminary classifier for automatic two-stage Land Cover classification and Change detection**

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**SIAM™ as a deductive physical model-based preliminary classifier**

SIAM™ is an automatic, multi-sensor, multi-resolution, near real-time, non-adaptive (deductive, physical model-based) decision-tree classifier based on prior spectral knowledge of surface types observed from space. Its prior spectral knowledge base comprises a reference dictionary of spectral signatures in top-of-atmosphere reflectance or surface reflectance, acquired from off-line data observations and/or existing literature. Since its knowledge base is available before looking at the specific image to be classified, SIAM™ belongs to the family of physical models, also called deductive inference systems. Employed as a preliminary classification first stage of a two-stage remote sensing image understanding system, SIAM™ enforces a shift in learning paradigm from traditional first-stage inductive Machine-Learning-from-data (e.g., image segmentation) to deductive Machine-Teaching-by-rules.

**First-stage SIAM™ preliminary classification onto a discrete and finite set of spectral categories**

The first-stage SIAM™ preliminary classifier requires as input multi-spectral images radiometrically calibrated into top-of-atmosphere or surface reflectance, and brightness temperature. SIAM™ is pixel-based (non-contextual), i.e., it is based on spectral properties exclusively. It maps each pixel onto a discrete and finite set of spectral categories (spectral-based semi-concepts, land cover class sets) belonging to a set of six spectral super-categories (spectral end members): (I) clouds, (II) snow or ice, (III) water or shadow, (IV) vegetation, (V) bare soil or built-up, and (VI) outliers.

**SIAM™ multi-sensor multi-resolution capabilities**

SIAM™ is a multi-sensor multi-resolution classification system of systems eligible for use with all existing spaceborne optical sensors whose: (a) spectral resolution overlaps with, but is inferior to, Landsat’s and (b) spatial resolution ranges from 0.5 m (pan-sharpened WV-2) to 3 km (Meteosat SEVIRI). SIAM™ consists of six sub-systems:

- 7-band Landsat TM-like (L-SIAM, 95/47/18 spectral categories)
- 4-band SPOT HRVIR-like (S-SIAM, 68/40/15 spectral categories)
- 4-band AVHRR-like (AV-SIAM, 82/42/16 spectral categories)
- 5-band AATSR-like (AA-SIAM, 82/42/16 spectral categories)
- 4-band IKONOS-like (I-SIAM, 52/28/12 spectral categories)
- 3-band DMC-like (D-SIAM, 52/28/12 spectral categories)

**Operational quality indicators of SIAM™**

- Degree of automation. Fully automatic (no user-defined parameter, no training samples).
- Efficiency. Near real-time (less than 5 min to classify a Landsat scene with a laptop computer).
- Accuracy. > 90% (evaluated globally up to Stage 2, i.e., across a range of representative conditions and a variety of spaceborne sensors).
- Robustness to changes in the input data set acquired across time, space, and sensors. Very high, refer to literature.
- Maintainability, scalability, reusability. Eligible for use with all spaceborne multispectral optical sensors.
- Timeliness. Real time processing with no user supervision.
- Economy. Maximized (no manpower, low computing power).

**Essential references**

- SIAM™ is a registered trademark of Andrea Baraldi and University of Maryland