## Big Data and Opinion Mining

The objective of our EC-funded DICODE project is to facilitate and augment collaboration and decision making support in data-intensive and cognitively-complex disparate research disciplines. The DICODE project aims to develop innovative big data methodologies by providing seamless integration and interoperability among existing and new applications under a unique web-based platform. This platform will enable users to work collaboratively, sharing applications and data, to facilitate the decision making tasks. The DICODE approach and platform have been evaluated by experts in three different domains: bioinformatics, medical informatics and social media, with the participation of various leading companies in this area. Text and opinion mining techniques were applied to analyze 'big data' coming from specialized literature and the unstructured Web 2.0. Information in the social networks can facilitate access to population trends and attitudes, which must be analyzed and filtered using cutting-edge techniques and approaches.

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## AFRICA BUILD

For many years, foundations and non-governmental organizations have focused their efforts in Africa by donating cash, electronic devices, or even whole labs. However, a fundamental gap for creating a solid scientific infrastructure is the lack of trained staff and academic professionals. In this context, we coordinate the AFRICA BUILD project to build the infrastructures needed to increase learning, research and collaborative health activities in Africa. We have created the first social network for African biomedical researchers through the AFRICA BUILD Portal —a "facebook for medical professionals in Africa". This facility includes many free and open technological and educational resources for training and support of African students and professionals. Two pilot projects related to training in HIV-AIDS and reproductive health were designed as a proof of the AFRICA BUILD concept. With such an approach, we are building a network of virtual communities in various biomedical topics, fostering new collaborative South-South biomedical initiatives.

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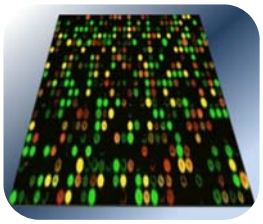
## Clinical Trials and Cancer Research



Since 2004, we have been working on developing models and tools to integrate clinical trials databases, following semantic approaches. Years after working on ACGT (advanced clinic-genomic trials on cancer), the objective of our FP7 INTEGRATE and EURECA projects is to advance research in oncology through a unique accessible biomedical infrastructure integrating diverse datasets, building predictive bionetworks and offering advanced tools to guide diagnosis and therapeutics. Based on multi-centric clinical trials programmes on breast cancer and other oncology domains, INTEGRATE and EURECA exploit a collaborative environment to combine multi-scale biomarkers (from genetic level to tissue level including imaging biomarkers) to define a methodology to improve the prognostic power of practices for assessing modern therapies in cancer treatment. Working together with partners such as Philips and various leading oncology centers from Europe, we aim to develop a new framework for future clinical trials.

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## Image Analysis and Processing

Applications of digital imaging include the enhancement and filtering of noisy images, the segmentation of regions of interest, the extraction of measurements, and shape processing. The main areas of our work have been the following:

(a) Theoretical and practical aspects of morphological connected filtering (which can preserve the shapes and forms in input images), including the so-called "levelings".

(b) Shape interpolation methods that allow to impose shape inclusion restrictions that can preserve, if desired, certain homotopy properties of the interpolated images.

(c) Segmentation techniques, such as variants of the morphological watershed that include shape constraints, and region merging methods. Some application domains have been the segmentation of internal structures of the brain and the extraction of particles in pathology.

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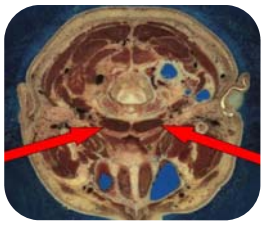
## Biomedical Applications in Imaging



Doctors need tools to use and to manage volumetric radiological data (three-dimensional imaging data, such as TC and MRI). We have worked on applications of 3D visualization of radiological data to navigate inner parts of the body and to model inner structures (using image segmentation techniques as well). We aimed to utilize relatively inexpensive equipment, such as PCs with specialized volumetric visualization hardware, for surgical planning purposes in virtual endoscopies.

We have also worked on medical imaging databases and PACS that are scalable and that can be used in both department-wide applications and in isolated workstation settings. Such applications benefit from an easy-to-use medical image explorer to interact with image databases, allowing, if desired, remote collaboration sessions among doctors.

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