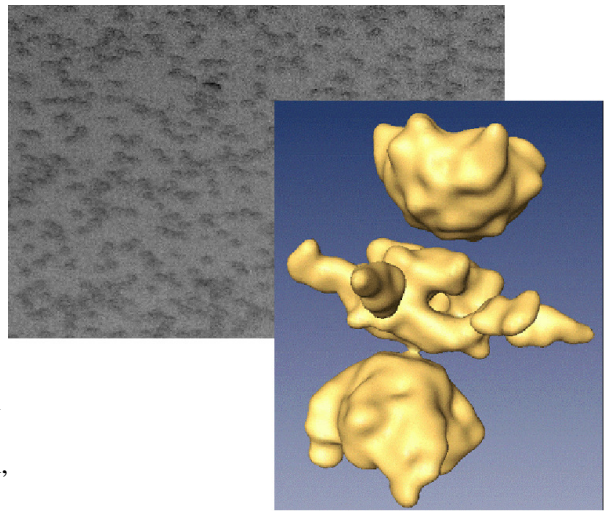
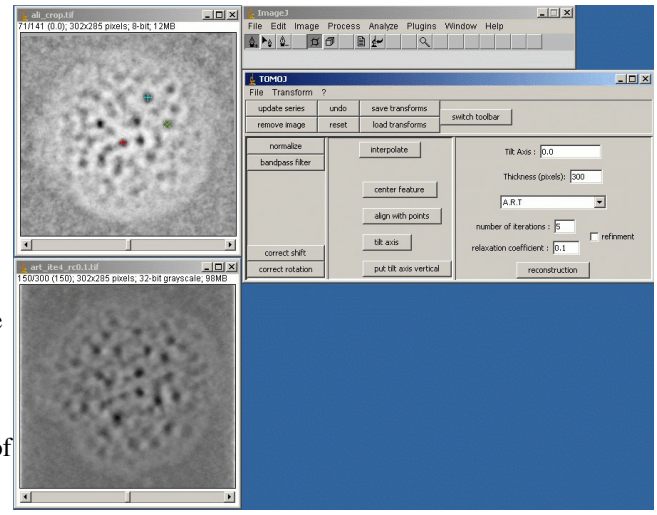
Visual proteomics and genomics aim at visualizing the structure and structural relationships of proteins (products of the gene expression) in the live cells and live organisms. The achievement of this goal involves the integration of several levels of imaging scales. For this reason, this research line is called integrative imaging.

First level (protein structure). First of all, it is important to determine the structure of the individual proteins or macromolecular complexes. For doing this, several experimental techniques are available such as X-ray crystallography, Nuclear Magnetic Resonance or Transmission Electron Microscopy. Our group has a long experience studying the structure of macromolecular complexes by applying signal processing and engineering techniques to the electron micrographs acquired by the transmission electron microscope. The problems involved in this acquisition are many from the point of view of image processing: image downsampling, transfer function estimation and correction, estimation of the power spectrum density, pattern recognition and classification, 3D reconstruction from 2D projections, evaluation of the reconstruction resolution, etc.



Over the years, we have developed multitude of image processing algorithms that are embedded into the Xmipp image processing package, which is used worldwide.

Second level (cellular components). The second level of structural information is provided by the spatial disposition of proteins to form cellular components. The understanding of the spatial relationships between the different structural components inside the cell is crucial to the full understanding of their functions. In our group, we have participated of the development of TomoJ, a software package specifically aimed at producing high-quality 3D reconstruction of cells or cellular components at the same time that it is very user-friendly and fast.



Third level (tissues). Cells integrate into tissues, and it would be interesting to study protein expression levels in tissues although currently we are not developing any work along this line.

Fourth level (organisms). The fourth level of integration are living organisms in which tissues orchestrate the behvior and functioning of living beings. In the context of full living organisms it is important to determine the areasof the body expressing this or that gene. This can be accomplished by means of radioactive markers specifically aimed at the gene product being imaged. The radiolabel is imaged by means of a gamma camara thanks to the effect of a positron anhiliation. This is called Positron Emission Tomography (PET). In this context, we have started to study the reconstruction algorithms needed for continuous gamma camaras.