Image Processing on Projections and Its Applications for Image Reconstruction

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Related projects:  
• Discrete Image Reconstruction from Uncertain and Insufficient Data [13]

Lifetime from: 2009  
Lifetime to: 2013

Short description: The aim of this project is to improve the well-known methods of continuous and discrete tomography. We study image processing methods that can be applied directly on the projections to improve reconstruction quality. We improve techniques to measure the quality of the reconstructed images, and develop image reconstruction methods based on parallel processing using GPUs. We also investigate which are the most valuable projections, if the reconstruction is performed from just a few of them.

Description:  
Reconstruction tomography produces 2-dimensional cross-sections of 3-dimensional objects from their projections taken from several directions. Depending on the reconstruction task, projections can be acquired by X-rays, gamma-rays, etc. In the most common situation radiation is generated outside the object (CT), in other scenarios the object itself emits gamma-rays (SPECT, PET). In image reconstruction the task is – roughly speaking – to backproject the sinogram consisting of the projections of the original image. This is usually performed by filtered backprojection (FBP) or algebraic iterative methods (ART, SART, SIRT). In practice, projections are taken from discrete angles, and they are noisy, too. The aim of this project is to improve the well-known methods of continuous and discrete tomography, and especially the followings:

• study of image processing methods, that can be applied directly on the projections to improve reconstruction quality (active contours, segmentation, edge-detection, denoising, etc.)
• incremental reconstruction by identifying important projection angles
• improving techniques to measure the quality of the reconstructed images (similarity to model image, statistical features, smoothness, etc.)
- measuring the information content of projections
- determination of attenuation coefficients from the sinogram for certain classes of images
- developing efficient discrete image reconstruction methods of novel types, based on parallel processing using GPUs where possible

**Publications:**

- **Projection selection dependency in binary tomography** [14], **Varga, László Gábor** [15], **Balázs Péter** [16], and **Nagy Antal** [17], ACTA CYBERNETICA-SZEGED, 2011, Volume 20, Issue 1, Szeged, p.167 - 187, (2011)
- **Direction-dependency of a binary tomographic reconstruction algorithm** [18], **Varga, László Gábor** [15], **Balázs Péter** [16], and **Nagy Antal** [17], Computational Modeling of Objects Represented in Images, May 2010, Number 6026, Buffalo, NY, USA, p.242 - 253, (2010)
- **Direction-dependency of binary tomographic reconstruction algorithms** [20], **Varga, László Gábor** [15], **Balázs Péter** [16], and **Nagy Antal** [17], GRAPHICAL MODELS, Nov 2011, Volume 73, Issue 6, p.365 - 375, (2011)
- **A central reconstruction based strategy for selecting projection angles in binary tomography** [22], **Balázs, Péter** [16], and **Batenburg Joost K.** [23], Image Analysis and Recognition, June 2012, Number 7324, Berlin; Heidelberg; New York; London; Paris; Tokyo, p.382 - 391, (2012)
- **Local uncertainty in binary tomographic reconstruction** [24], **Varga, László Gábor** [15], **Nyúl László Gábor** [25], **Nagy Antal** [17], and **Balázs Péter** [16], Proceedings of the IASTED International Conference on Signal Processing, Pattern Recognition and Applications (SPPRA 2013), Feb 2013, Calgary, p.490 - 496, (2013)
- **Dynamic angle selection in binary tomography** [26], **Batenburg, Joost K.** [23], **Palenstijn Willem Jan** [27], **Balázs Péter** [16], and **Sijbers Jan** [28], COMPUTER VISION AND IMAGE UNDERSTANDING, 2013, Volume 117, Issue 4, p.306 - 318, (2013)

**Kategória:** Tomography - Discrete Tomography

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