O. Langthaler, *Incorporation of the Superiorization Methodology into Biomedical Imaging Software*, Marshall Plan Scholarship Report, Salzburg University of Applied Sciences, Salzburg, Austria, and The Graduate Center of the City University of New York, NY, USA, September 2014, (76 pages).
http://www.marshallplan.at/images/papers_scholarship/2014/Salzburg_University_of_Applied_Sciences_LangthalerOliver_2014.pdf

Abstract

Imaging software often relies on iterative algorithms for the reconstruction of images from projections, such as ART, SART or MLEM. However, many of these algorithms only optimize a single criterion and some of them exhibit certain drawbacks, such as MLEM, which is prone to noise overftting at higher iteration numbers. In order to improve results, it is thus often advantageous to introduce an additional optimization criterion, such as the extent to which certain properties of a reconstruction match expected values or how well it matches data from an additional data source. Developing such a modified algorithm can be a mathematically challenging task, which may take considerable time to develop.

Superiorization is a newly developed heuristic for constrained optimization problems and provides a generic answer to these challenges. While, unlike their exact counterparts, heuristic approaches may not always produce an output which tends toward the optimum of a given criterion, they provide a nearly immediate solution and are nonetheless capable of producing feasible results. Additionally, they tend to require considerably fewer computational resources, which is why they have often been found useful in optimization applications.

The aim of the underlying work is the incorporation of Superiorization into SNARK09, resulting in a new version, SNARK14. SNARK is a programming system for the reconstruction of images from projections (such as CT and PET scans) and is intended to help researchers interested in developing and evaluating reconstruction algorithms. Upon a thorough evaluation of its code structure, a new module, named Superiorization, is introduced into the SNARK package. The main focus is to design this module to be as flexible as possible for various iterative algorithms and optimization criteria.