Extrapolation methods and their applications

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Timetable: 16 hrs. Lectures on April/May 2012 (see the calendar), Room 2BC/30, Torre Archimede.

Course requirements: No special requirement is needed for this course. Only some fundamental knowledge of numerical analysis, but it could be acquired simultaneously with the lectures.

Examination and grading: Grading is based on homeworks or a written examination or both.

SSD: MAT/08 Numerical Analysis

Aim: These lectures are intended to students and researchers in pure and applied mathematics, in numerical analysis, and in scientific computing.

Course contents:

1. Sequence transformations and convergence acceleration
   When a sequence is slowly converging, one can transform it, without modifying its terms, into a new sequence which, under some assumptions, converges faster to the same limit. The theory of such sequence transformations will be studied.
2. What is an extrapolation method?
   Sequence transformation are showed to be, in fact, based on the idea of extrapolation which will be explained.
3. Various extrapolation methods
   We will describe various sequence transformations and the recursive algorithms which are used for implementing them.
4. Vector sequence transformations
   There exist special sequence transformations for accelerating the convergence of sequences of vectors. They will be reviewed.
5. Applications
   Sequence transformations and extrapolation algorithms have many applications outside the domain of convergence acceleration. We will consider the following ones
   (a) Treatment of the Gibbs phenomenon
   (b) Web search
   (c) Estimation of the error for linear systems
   (d) Estimation of the trace of the inverse of a matrix
   (e) Regularization of linear systems

References

[1] C. Brezinski, M. Redivo-Zaglia, *Extrapolation Methods. Theory and Practice*, North–Holland, Amsterdam, 1991.

[2] J.P. Delahaye, *Sequence Transformations*, Springer-Verlag, Berlin, 1988.

[3] A. Sidi, *Practical Extrapolation Methods. Theory and Applications*, Cambridge University Press, Cambridge, 2003.

[4] E.J. Weniger, Nonlinear sequence transformations for the acceleration of convergence and the summation of divergent series, Computer Physics Reports, 10 (1989) 189-371.

[5] J. Wimp, *Sequence Transformations and their Applications*, Academic Press, New York, 1981.