
Applied Numerical Methods : LAB8

GOYENS Florentin & WEICKER David

10th December 2015

Introduction

This report presents results for the eighth lab for the course Applied Numerical Method. The problem consists of computing the solution of an underdetermined system using SVD decomposition.

The system to solve comes from the numerical discretization of the Fredholm's integral equation and will sometimes be truncated to a certain rank r.

Building the system

fzcesdw

SVD decomposition for solving the system

This section focuses on solving the underdetermined system derived in the previous section. To do this, SVD factorization will be used.

We know that our system is composed by 36 equations for 59 unknowns. It is thus indeed underdetermined.

Let us recap the strategy used to solve the system. We start with

$$Ap = f.$$

We get the decomposition

$$A = USV^T.$$

This yields

$$\begin{aligned} USV^T p &= f && (1) \\ S\underbrace{V^T p}_{z} &= \underbrace{U^T f}_{d} && (2) \\ & && (3) \end{aligned}$$

S is diagonal with the singular values. We decide to keep the r first singular values and set the other ones to zero. This correspond to looking for a least square solution in a subspace of $Col(A)$ but reduces the sensitivity of the problem to data perturbations.

We set $z_i = d_i/s_i$ for $i = 1 : r$. The other $z_i = 0$ for $i = r+1, \ldots, N$ give the minimum norm solution. Finally we recover the solution $p = Vz$ because we set $z = V^T p$ in the beginning.

We look at the results we get without adding any noise to the data f.

figures to come hooooooo