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Inverse Problems - Worksheet 5 Winter term 2019/2020

1 Consolidation assignment

Use TSVD to solve the inverse heat equation. This is essentially the same problem as last week's (i.e. you can now try it again if you had trouble last time), but now explicitly in the setting of truncated SVD. Start with the skeleton code for the inverse heat equation which you can find on StudOn. The goal is to have a passable reconstruction of the initial temperature. Play around with the parameters `T` (the length of the time evolution), `sigma` (the strength of the noise) and `K` (the cutoff parameter for the TSVD). You will use the code again in order to test a different reconstruction.

2 Preparation assignment

1) **Peruse** the pdf titled "Tikhonov regularization" in StudOn.

2) Complete the **short survey** "Workload and worksheets of the lecture" in StudOn in order to help us to improve the teaching quality of this course

3) Compute explicitly the TSVD and the classical Tikhonov regularization in dependence of the regularization parameter α for the inverse problem

$$y = Ax,$$

where $A \in \mathbb{R}^{n\times n}$ is a diagonal matrix with diagonal values $a_1 \geq a_2 \geq \ldots \geq a_n \geq 0$ and we assume that $a_1, \ldots, a_m > 0$ for some $m \in \{1, \ldots n\}$.

4) Apply Tikhonov regularization in order to solve the inverse heat equation. Compare this to your results with TSVD from the consolidation assignment. Play around with all the parameters involved.

One randomly chosen team will present their results from this assignment and the consolidation assignment in class on November 19th. Prepare for a short presentation of maximum 10 minutes where you explain your code, demonstrate your reconstruction with TSVD and classical Tikhonov and its dependency from parameters `T` *(the length of the time evolution),* `sigma` *(the strength of the noise),* `K` *(the cutoff parameter for the TSVD) and* `alpha` *(the regularization parameter from Tikhonov). In order to work on this assignment, you may use the PC pool "Praktikum 1" on Friday from 10-12am.*

3 Notes / Insights from class