Otto-von-Guericke-Universität Magdeburg
Fakultät für Mathematik – Institut für Analysis und Numerik
Max-Planck-Institut für Dynamik komplexer technischer Systeme
Computational Methods for Systems and Control Theory

Wintersemester 2019/20
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Numerical Linear Algebra – 2. Übung

Exercise 1 (Householder transformation)

Let $P = I_n - vv^\top$, where $v \in \mathbb{R}^n,\ \|v\|_2 = 1$. Verify that P is a projection operator. What is the kernel of P? Illustrate the projection in a figure.
Let $H = I_n - 2vv^\top$. Prove that H is invertible. What is its inverse? What is the geometric interpretation of H?
Let $x,\ y$ be given vectors with $\|y\|_2 = 1$. Let $u = x - \|x\|_2 y$ and $v = \frac{u}{\|u\|_2}$. Compute Hx.
Compute the QR decomposition of the matrix $A = \begin{bmatrix} 7 & -6 & -1 \\ -1 & -4 & 2 \\ 7 & -11 & 4 \\ -2 & -2 & -1 \end{bmatrix}$ by using matrices of the form H.

Exercise 2 (Givens rotations)

Compute the QR decomposition of the matrix $A = \begin{bmatrix} 7 & -6 & -1 \\ -1 & -4 & 2 \\ 0 & -4 & -3 \\ 0 & 0 & -3 \end{bmatrix}$ by using Givens rotations.