Mathematik für Engineering Science I WS 2021/22

#### Übungsaufgaben zu Thema 11 Eigenwerte und Eigenvektoren

(z.T. mit Lösungen)



#### Aufgabe 1

Es seien  $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$  die Koordinaten eines Vektors  $\vec{x}$  bezüglich der Basis  $\mathcal{B} = \{\vec{b}_1, \vec{b}_2, \vec{b}_3\}$  mit

$$\vec{b}_1 = \left( \begin{smallmatrix} 0 \\ \frac{1}{2} \end{smallmatrix} \right), \quad \vec{b}_2 = \left( \begin{smallmatrix} 1 \\ -1 \end{smallmatrix} \right), \quad \vec{b}_3 = \left( \begin{smallmatrix} -1 \\ \frac{1}{4} \end{smallmatrix} \right).$$

Welche Koordinaten besitzt  $\vec{x}$  bezüglich der Standardbasis  $\mathcal{E} = \{\vec{e_1}, \vec{e_2}, \vec{e_2}\}$ ? Angenommen der Vektor  $\vec{y}$  hat die Koordinaten  $\begin{pmatrix} \frac{1}{2} \\ \frac{1}{2} \end{pmatrix}$  in der Standardbasis. Welche Koordinaten hat  $\vec{y}$  bezüglich der Basis B?

Anleitung: Beschreiben Sie die Basiswechsel mittels der Matrix  $M=(\vec{b}_1\,|\,\vec{b}_2\,|\,\vec{b}_3)$  bzw. deren inverser Matrix?

Lösung:

Die aus den Vektoren der Basis B gebildete Matrix M.

$$M = \begin{pmatrix} 0 & 1 & -1 \\ 1 & 2 & 1 \\ 2 & -1 & 4 \end{pmatrix}.$$

dient zur Umrechnung von Koordinaten bezüglich der Basis B in Koordinaten bezüglich der Standardbasis.

Der Vektor x mit den Koordinaten  $x_B = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$  bezüglich der Basis B hat bezüglich der Stan-

daydbasis die Koordinaten

$$\mathbf{x}_E = M\mathbf{x}_B = \begin{pmatrix} 0 & 1 & -1 \\ 1 & 2 & 1 \\ 2 & -1 & 4 \end{pmatrix} \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} = \begin{pmatrix} -1 \\ 8 \\ 12 \end{pmatrix}.$$

Um Koordinaten bezüglich der Standardbasis in Koordinaten bezüglich der Basis B zu transformieren, benötigt man die inverse Matrix  $M^{-1}$ .

Wir berechnen die inverse Matrix M-1 mit dem Gaus-Jordan-Algorithmus, indem wir (M | I2)

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**M Lipman** 

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