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Corrigendum

Corrigendum to "Solvability and uniqueness criteria for generalized Sylvester-type equations" ☆

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ABSTRACT

We provide an amended version of Corollaries 7 and 9 in [De Terán, Iannazzo, Poloni, Robol, "Solvability and uniqueness criteria for generalized Sylvester-type equations"]. These results characterize the unique solvability of the matrix equation $AXB + CX^{\star}D = E$ (where the coefficients need not be square) in terms of an equivalent condition on the spectrum of certain matrix pencils of the same size as one of its coefficients.

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Matrix pencil
Matrix equation

1. Setting

We consider the *generalized ⋆-Sylvester equation*

$$AXB + CX^{\star}D = E \tag{1}$$

for the unknown $X \in \mathbb{C}^{m\times n}$, with $\star$ being either the transpose ($\top$) or the conjugate transpose ($*$), and $A \in \mathbb{C}^{p\times m}, B \in \mathbb{C}^{n\times q}, C \in \mathbb{C}^{p\times n}, D \in \mathbb{C}^{m\times q}$.

We follow the same notation and definitions as in [2], but we need to introduce some further notions. In particular, we deal with certain matrices and matrix pencils that always have $|m-n|$ zero or infinite eigenvalues which are *dimension-induced*, that is, they are present simply because of the sizes of the coefficient matrices they are constructed from (see [4]). Hence we define a variant of the spectrum in which these eigenvalues are omitted:

$$\widehat{\Lambda}(\mathcal{P}) := \begin{cases} \Lambda(\mathcal{P}), & \text{if } m_\infty(\mathcal{P}) > |m-n|, \\ \Lambda(\mathcal{P}) \setminus \{\infty\}, & \text{if } m_\infty(\mathcal{P}) = |m-n|, \end{cases}$$

$$\widetilde{\Lambda}(\mathcal{P}) := \begin{cases} \Lambda(\mathcal{P}), & \text{if } m_0(\mathcal{P}) > |m-n|, \\ \Lambda(\mathcal{P}) \setminus \{0\}, & \text{if } m_0(\mathcal{P}) = |m-n|. \end{cases}$$

Following [4], we refer to the eigenvalues in either $\widehat{\Lambda}(\mathcal{P})$ or $\widetilde{\Lambda}(\mathcal{P})$ as *core eigenvalues*. If M is a square matrix, we use the notation $\widetilde{\Lambda}(M)$ to denote $\widetilde{\Lambda}(\lambda I - M)$. We recall that the pencil $\mathcal{P}(\lambda)$ has an infinite eigenvalue if and only if its reversal, $\operatorname{rev}\mathcal{P}(\lambda)$, has the zero eigenvalue. The multiplicity of the infinite eigenvalue in $\mathcal{P}(\lambda)$ is the multiplicity of the zero eigenvalue in $\operatorname{rev}\mathcal{P}(\lambda)$, thus

$$\widetilde{\Lambda}(\operatorname{rev}\mathcal{P}) = \left\{\lambda^{-1} \ : \ \lambda \in \widehat{\Lambda}(\mathcal{P})\right\}, \tag{2}$$

with $0^{-1} = \infty$ and $\infty^{-1} = 0$.

By $\lambda^\star$ we denote either λ, if $\star = \top$, or $\bar{\lambda}$, if $\star = *$, with $\bar{\lambda}$ being the complex conjugate of λ.

2. Amended corollaries

In [2], we provided several corollaries that convert the conditions in [2, Theorem 3] into conditions on pencils and matrices of smaller size. Unfortunately, some issues with

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