Bernard Brogliato

To cite this version:

HAL Id: hal-03364924
https://inria.hal.science/hal-03364924v3
Preprint submitted on 7 Sep 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Bernard Brogliato∗

September 7, 2022

(I will be glad to receive any comment which helps me to improve this Erratum/Addendum. Updates are published at hal.inria.fr). This erratum corresponds to the uncorrected version of the third edition.

• page 56, Lemma 2.64: \( H(s) \) is proper, so it is expandable in nonnegative powers of \( \frac{1}{s} \) near \( s = \infty \).

• page 94 Lemma 3.16, 1: \( \mu_{\text{min}}(L) \) is \( \lambda_{\text{min}}\left(\frac{1}{2}(L + L^T)\right) \).

• section 3.1.7: there exists a canonical form for descriptor variable systems which are passive, as shown in references [47,50] page 246. Let \((E,A,B,C,D)\) in (3.55) have a transfer function which is positive real, and the state space realisation in (3.55) be minimal (see [50] for minimality conditions for descriptor variable systems). Then the canonical form is a special Weierstrass form which writes as:

\[
\begin{aligned}
\dot{x}_1 &= A_1 x_1 + B_1 u \\
\dot{x}_2 &= x_3 + B_2 u \\
0 \times \dot{x}_3 &= 0 = x_2 + B_3 u \\
y &= C_1 x_1 + C_2 x_2 + C_3 x_3 + Du,
\end{aligned}
\]

where \(x_3\) is the algebraic variable. It can be shown that the quadruple \((A_1, B_1, C_1, \dot{D})\) is passive, with \(\dot{D} = D - C_3 B_2 - C_2 B_3\), and there exists a matrix \(P_3 = P_3^\top \succeq 0\) such that \(B_3^\top P_3 = -C_3\). The system verifies a LMI as in (3.150) (with relevant matrices) for some \(P_1 = P_1^\top \succeq 0\). If the system is strongly SPR and minimal then \(P_1 \succ 0\). Storage functions of the descriptor variable system are of the form \(\frac{1}{2}x_1^\top P_1 x_1 + \frac{1}{2}x_2^\top P_3 x_2\).

• page 107, line -3, replace “for all \(x \in W\)” by “for all \(x \in \text{Im}(W)\)”.

• page 142, line 4 inside Remark 3.64: replace “Item 4” by “item 2”.

• page 147, replace all “(3.165)” by (3.162) and all “(3.166)” by (3.163).

∗INRIA Grenoble, Université Grenoble-Alpes, 655 avenue de l’Europe, Inovallée, 38334 Saint-Ismier, France. bernard.brogliato@inria.fr
Lemma 1 (corrected Lemma 3.94) Let $D > 0$, and let $\Phi : \mathbb{R}^m \rightrightarrows \mathbb{R}^m$ be a maximal monotone mapping. Then the generalised equation $y \in Cx - D\Phi(y)$ has a unique solution.

Proof: $y \in Cx - D\Phi(y) \iff D^{-1}y + \Phi(y) \ni D^{-1}Cx \iff (D^{-1} + \Phi)(y) \ni D^{-1}Cx \iff y \in (D^{-1} + \Phi)^{-1}(D^{-1}Cx)$. There are several ways to prove the result. Consider the mapping $A : y \mapsto A(y) = (D^{-1} + \Phi)(y)$. Let $x_1, x_2 \in \text{dom}(A)$, $y_1 \in A(x_1)$, $y_2 \in A(x_2)$. Then $\langle x_1 - x_2, y_1 - y_2 \rangle = \langle x_1 - x_2, D^{-1}(x_1 - x_2) \rangle + \langle x_1 - x_2, \xi_1 - \xi_2 \rangle$ where $\xi_1 \in \Phi(x_1), \xi_2 \in \Phi(x_2)$. Thus $\langle x_1 - x_2, y_1 - y_2 \rangle \geq \langle x_1 - x_2, D^{-1}(x_1 - x_2) \rangle$ (using the monotonicity of $\Phi(\cdot)$), and thus $\langle x_1 - x_2, y_1 - y_2 \rangle \geq \frac{1}{2} \lambda_{\min}(D^{-1} + D^{-T}) \langle x_1 - x_2, x_1 - x_2 \rangle$ (since $D^{-1} > 0$ and thus $D^{-1} + D^{-T} > 0$). Therefore the mapping $A(\cdot)$ is strongly monotone, and so is the mapping $y \mapsto -D^{-1}Cx + A(y)$. Using [3, Proposition 23.36, Corollary 23.37], it follows that the generalised equation $0 \in -D^{-1}Cx + A(y)$ has a unique solution.

The result also follows from the application of [1, Theorem 3.3], that is itself a consequence of [6, Corollary 32.25]. It states that the generalised equation $z \in F(y) + G(y)$ with $F(\cdot)$ single-valued Lipschitz continuous and strongly monotone and $G(\cdot)$ set-valued maximal monotone, always has a unique solution. Here the generalized equation is $D^{-1}y + \Phi(y) \ni D^{-1}Cx$, hence the result follows. When $\Phi = \partial \phi$ for some proper convex lower semicontinuous function $\phi(\cdot)$, then the result follows from Proposition 1 in reference [278] page 255, which states that the operator $(D^{-1} + \Phi)^{-1}(\cdot)$ is Lipschitz continuous, single-valued and well-defined. $\Box$

Notice that $D$ needs not be symmetric for the Lemma to hold. Assume in addition that $D = D^\top$, and let $D = R^2$, $R = R^\top > 0$. The generalised equation is equivalent to $R^{-1}y \in R^{-1}Cx - R\Phi(RR^{-1}y)$. Define $z = R^{-1}y$, then $z \in R^{-1}Cx - R\Phi(Rz)$. The mapping $\tilde{\Phi} : z \mapsto R\Phi(Rz) = \tilde{R}^\top\Phi(Rz)$ is maximal monotone. The generalised equation $z \in R^{-1}Cx - R\Phi(Rz) \iff z + \tilde{\Phi}(z) \ni R^{-1}Cx \iff z \in (R^{-1} + \tilde{\Phi})^{-1}(R^{-1}Cx)$. If $\Phi = \partial \phi$ for some proper, convex lower semicontinuous function $\phi(\cdot)$, then Lemma A.98 (page 692) can be applied to conclude about uniqueness of the solution.

Another result can be stated:

Lemma 2 (corrected Lemma 3.94) Let $D$ be a P-matrix, and let $\Phi : \mathbb{R}^m \rightrightarrows \mathbb{R}^m$ be defined as $\Phi(y) = \partial \psi_K(y)$, where $K = \mathbb{R}^m_+$, and $\psi_K(\cdot)$ is its indicator function. Then the generalised equation $y \in Cx - D\Phi(y)$ has a unique solution.
• page 441, first line in (6.53) has to be changed to:

\[ \dot{x}(t) = J_s \nabla H_0(x(t)) - \sum_{i=1}^{m} \nabla H_i(x(t)) \; u_i(t) \]

• page 442, (6.56) has to be changed to:

\[
\begin{pmatrix}
\dot{q}(t) \\
\dot{p}(t)
\end{pmatrix}
= \begin{pmatrix}
0 & 1 \\
-1 & 0
\end{pmatrix}
\begin{pmatrix}
kq(t) \\
p(t)
\end{pmatrix}
\begin{pmatrix}
\dot{u}_1(t) \\
\dot{u}_2(t)
\end{pmatrix}
\]
• page 450, (6.78) and lines before have to be changed to: “...there exist interaction Hamiltonian functions such that: \[ g_i(x) = -J(x)\nabla H_i(x). \] The port conjugated outputs are then: \[ y_i = \nabla H_0^\top(x)g_i(x) = -\nabla H_0^\top(x)J(x)\nabla H_i(x). \] The natural outputs are: \[ \tilde{y}_i = H_i(x). \] Using the drift dynamics in (6.67), their derivatives are computed as:

\[
\dot{\tilde{y}}_i(t) = dH_i^\top(x(t))\dot{x}(t) = y_i(t) - \sum_{j=1,j\neq i}^m u_j dH_i^\top(x(t))J(x(t))dH_j(x(t))
\]


• page 670, Proposition A.68: the items 2 and 3 of the second part of the proposition, have to be deleted since they are not equivalent to \( M \succ 0 \). Same has to be done with the corresponding result in Bernstein’s book (Fact 8.15.12 in the first edition, Fact 8.21.22 in the second edition [4], Fact 10.24.25 in the third edition [5]). The reason why is that item 2 does not imply that \( M_{12} = 0 \) when \( M_{22} = 0 \), and item 3 does not imply that \( M_{12} = 0 \) when \( M_{11} = 0 \) (though it should, as can be deduced for instance from Lemma A.70). Only items 1, 4 and 5 have to be used. Unfortunately I realized this after the corrected version of the third edition was published. It is therefore still present in the corrected version. Prof. Bernstein has been informed about this error.

• page 670, Proposition A.68: In item 3 of the first part of the proposition: \( M_{12} = M_{12}M_{22}^\dagger M_{22} \).

• page 691, Lemma A.96: it is \(||x_1 - x_2||^2 \) (this typo is also present in the article [70]).

• page 692, Lemma A.98: The function \( \phi(\cdot) \) is proper, convex and lower semicontinuous.

References


