Robust $H_\infty$ Filter Design for a Class of High-speed Sampling Uncertain Systems

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Abstract The problem of robust $H_\infty$ filtering for Delta operator formulated systems with uncertain parameters residing in a polytope is investigated. Based on the bounded real lemma, new robust $H_\infty$ performance criterion by means of parameter-dependent Lyapunov function is presented. According to the new performance criterion, a sufficient condition for the full-order robust $H_\infty$ filter is derived in terms of linear matrix inequalities. The designed filter can be obtained from the solution of a convex optimization problem. The proposed filter design procedure is less conservative than the strategy based on the quadratic stability notion. A numerical example is given to show the feasibility of the proposed approach.

Key words: $H_\infty$ filtering; Linear matrix inequality; Bounded real lemma
等人的思想

\[ \int_0^T B \chi(t) C \, dt \]

\[ \Delta \]

\[ \mathcal{L} \]

\[ \mathcal{C} \]

\[ \gamma_2 \]

\[ T \int_0^{\infty} \alpha(k) \, \omega(k) \, z(k) \, \gamma \, \alpha \, \alpha \, > \, 0 \]

\[ \| \alpha \|_2 = \left[ T \sum_{k=0}^{\infty} \alpha(k) \, \omega(k) \right]^{1/2} \]

\[ \| T \|_2 \]

\[ \| z \|_2 = \left[ T \sum_{k=0}^{\infty} z^T(k) z(k) \right]^{1/2} \]

\[ \mathbf{M} \]

\[ \mathbf{A} \]

\[ \mathbf{B} \]

\[ \mathbf{C} \]

\[ \mathbf{P} \]

\[ \mathbf{S} \]

\[ \mathbf{T} \]

\[ \mathbf{H} \]

\[ \mathbf{A} \]

\[ \mathbf{B} \]

\[ \mathbf{C} \]

\[ \mathbf{D} \]

\[ \mathbf{E} \]

\[ \mathbf{F} \]

\[ \mathbf{G} \]

\[ \mathbf{H} \]

\[ \mathbf{I} \]

\[ \mathbf{J} \]

\[ \mathbf{K} \]

\[ \mathbf{L} \]

\[ \mathbf{M} \]

\[ \mathbf{N} \]

\[ \mathbf{O} \]

\[ \mathbf{P} \]

\[ \mathbf{Q} \]

\[ \mathbf{R} \]

\[ \mathbf{S} \]

\[ \mathbf{T} \]

\[ \mathbf{U} \]

\[ \mathbf{V} \]

\[ \mathbf{W} \]

\[ \mathbf{X} \]

\[ \mathbf{Y} \]

\[ \mathbf{Z} \]
\[ S - G^T \leq 0 \quad (13) \]
证明，

$$
\begin{align*}
G & \triangleq \begin{bmatrix} G_{11} & G_{12} \\ G_{21} & G_{22} \end{bmatrix},
S & \triangleq \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix},
\end{align*}
$$

(17)

$$
\begin{align*}
J_G & \triangleq \begin{bmatrix} I & G_{11} \\ 0 & G_{22} \end{bmatrix},
J_Z & \triangleq \begin{bmatrix} Z_{11} & 0 \\ 0 & Z_{22} \end{bmatrix},
\end{align*}
$$

(18)

$$
\begin{align*}
\Omega & \triangleq TA^T + I, \\
& \begin{bmatrix} \Omega & 0 \\ 0 & \Omega \end{bmatrix} < 0,
\end{align*}
$$

(19)

$$
\begin{align*}
S & \triangleq \begin{bmatrix} S_{11} & S_{12} \\ 0 & S_{22} \end{bmatrix},
J^2SJ_Z = (20)
\end{align*}
$$

$$
\begin{align*}
\Phi & \triangleq \begin{bmatrix} TA^T & 0 \\ 0 & TA^T \end{bmatrix},
\Phi & \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix},
\end{align*}
$$

(21)

$$
\begin{align*}
\Phi & \triangleq \begin{bmatrix} TA^T & 0 \\ 0 & TA^T \end{bmatrix},
\end{align*}
$$

(22)

$$
\begin{align*}
\Phi & \triangleq \begin{bmatrix} TA^T & 0 \\ 0 & TA^T \end{bmatrix},
\Phi & \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix},
\end{align*}
$$

(23)

$$
\begin{align*}
\Phi & \triangleq \begin{bmatrix} TA^T & 0 \\ 0 & TA^T \end{bmatrix},
\Phi & \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix},
\end{align*}
$$

(24)

$$
\begin{align*}
\Phi & \triangleq \begin{bmatrix} TA^T & 0 \\ 0 & TA^T \end{bmatrix},
\Phi & \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix},
\end{align*}
$$

(25)

$$
\begin{align*}
\Phi & \triangleq \begin{bmatrix} TA^T & 0 \\ 0 & TA^T \end{bmatrix},
\Phi & \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix},
\end{align*}
$$

(26)
\[ T(\mathbf{Y}) = \begin{bmatrix} \mathbf{Y} & \mathbf{I} & \mathbf{I} \\ \mathbf{Y} & \mathbf{I} & \mathbf{I} \end{bmatrix} \]


