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Algorithm for construction of *LMI*-domains of stability of modal control

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The dynamical system is *D*-stable if all its poles, that is, all the eigenvalues of the matrix, lie in the domain *D*. When *D* coincides with the entire left complex half-plane, *D*-stability is reduced to asymptotic stability. The matrix *A* is asymptotically stable only when there exists a symmetric matrix *X* satisfying the inequality

$$AX + XA^T < 0, \quad X > 0. \qquad (1)$$

Domain

$$D = \{z \in C : f_D(z) < 0\} \qquad (2)$$

isan*LMI*- domain (linearmatrixinequalitydomain) generatedby a function $f_D(z)$,thatis a characteristicfunction of the domain.Fromthedefinitionitfollowsthatthe*LMI*-domainis a subsetofthecomplexplane, whichisrepresentedby a linearmatrixinequalitywithrespecttovariables $x = \mathrm{Re}(z)$ and $y = \mathrm{Im}(z)$. Consequently, the *LMI*-domain is convex, but for any $z \in D$ take place, what the *LMI*-regions are symmetric with respect to the actual axis.In order to obtain the inequalities that determine the *LMI* - domains, the following ($m \times m$)- block matrix is brought into line with the function $f_D(z)$ $M(A,X) = P \otimes X + G \otimes (AX) + G^T \otimes (XA^T)$. (3)

The kronecker product of the matrices is called the block matrix, which is created by multiplying each element of the matrix *A* into the matrix *B*. Then blocks of the matrix*M (A, X)* can be written in a more convenient form.The stability theorem is known [1], in accordance with the mentioned theoremthe matrix *A* is *D*-stable only if there exists a matrix $X = X^T$ that satisfies the linear matrix inequalities

$$M(A,X) < 0, \quad X > 0. \qquad (4)$$

If the matrix (4) is multipliedby a matrix $E \otimes Y$, where E isthe unit matrix, then according to the properties of the kronecker product after transformations we obtain the criterion *D*- stability of the matrix *A*

$$L(A,Y) = P \otimes Y + G \otimes (YA) + G^T \otimes (A^T Y) < 0, \quad Y = Y^T > 0. \qquad (5)$$

Onthebasisofthestabilitytheoremonecanpropose [1] analgorithmforconstructing*LMI* - domainsthatdeterminethecriterion*D*-stabilityofsystems $\dot{x}(t) = Ax(t)$. Note one important property of the *LMI* - areas: *LMI* - the areas are locked in relation to the intersection operation, that is, the intersection of the *LMI* - the regions will also be *LMI*-area.

Literature

1. *Лобок О.П.* Застосування лінійних матричних нерівностей при синтезі модального керування багатомірними лінійними системами / О.П. Лобок, Б.М. Гончаренко, М.А. Сич // Журнал «Наукові праці НУХТ». Том 24, № 3. – К: НУХТ. 2018, с.16 – 25.