practically the same value of performance index $J(W_{*\infty}) \approx J(W_{0\infty}) = 25.779$.

As for the solution of the standard problem (5), with the help of MATLAB function ***hinfsyn*** obtain the optimal transfer function

$$W_{h\infty}(s) = \frac{2380s^2 + 3630s + 846}{s^3 + 472s^2 + 416s + 3650},$$

providing minimal value $J_{\infty 0} = 25.716$ of the functional $J_\infty(W)$. Remark that the average running time of synthesis for the default initial segment $J_{\infty 0} \in [0, 88.9]$ is equal to 0.08 s. By using the estimates obtained above, we can shrink initial segment, for example $J_{\infty 0} \in [0.95J_0, J_0]$, that reduces the running time more then twice.

Example 2: Consider the same control plant (1) as for the proceeding example and address to the irregular problem (7) with no noise. Using Algorithm 2, we consequently obtain $J_a = 0.9994$, $\rho_m^2 = 2.288$, $\rho_0^2 = 1.669$,

$$W_{0\infty}(s) = \frac{s^5 + 4.61s^4 + 8.55s^3 + 8.06s^2 + 3.88s + 0.764}{s^4 + 3.46s^3 + 4.49s^2 + 2.66s + 0.593}.$$

These data can be used for standard synthesis (5) to reduce a running time of calculations.

8 Conclusion

The main goal of the paper is to propose and to discuss a special spectral approach in frequency domain to partial case of H_∞-optimization problem for LTI controlled plants. Proposed approach is based on a polynomial representation of initial and temporary data and on a special parameterization of stabilizing controllers set. Instead of the Riccati equation (or linear matrix inequalities) solutions, here polynomial factorizations are used, that substantially simplifies algorithms of synthesis.

Proposed spectral approach is implemented to the H_∞-problem statement, which is some differed from the commonly used standard variant. The mentioned difference allows using the alternative problem and the algorithm of its solving as an auxiliary instrument with respect to the standard situation. First, this instrument gives the initial estimates for the standard H_∞-norm minimum that can essentially reduce the running time of synthesis.

Second, the spectral approach is quite suitable to solve the irregular problem with no measurement noise. This situation is directly unsolvable by «2-Riccati» method, however the spectral approach allows to overcome this difficulty additionally reducing the running time of synthesis.

Third, the spectral representation is convenient for various investigations of the system features.

Some disadvantage of proposed approach is an evident structure imperfection that can be overcome by reducing an order of the controller.

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References:

[1] B.A. Francis, *A course in H_∞ control theory*, vol. 88 in Lecture Notes in Control and Information Systems. New York: Springer-Verlag, 1987.

[2] J.C. Doyle, B.A. Francis, A.R. Tanenbaum, *Feedback Control Theory*. . New York: Mac Millan, 1992.

[3] S., Bhattacharyya, A. Datta, L. Keel, *Linear Control Theory: Structure, Robustness and Optimization*. Boca Raton, FL: CRC Press, Taylor & Francis Group, 2009.

[4] S. Boyd, S., L. El Ghaoui, E. Feron, V. Balakrishnan, *Linear Matrix Inequalities in System and Control Theory*. SIAM, Philadelphia, 1994.

[5] H. Kwakernaak, "H_2-Optimization – Theory and Applications to Robust Control Design," *Annu. Reviews in Control*, vol. 26, no 1, pp. 45–56, 2002.

[6] F.A. Aliev and V.B. Larin, "Parameterization of sets of stabilizing controllers in mechanical systems," *Int. Appl. Mech.*, vol. 44, no. 6, pp. 599 – 618, 2008.

[7] K. Zhou, *Essentials of Robust Control*. New Jersey: Prentice Hall, 1998.

[8] D.C. Youla, H.A. Jabr, and J.J. Bongiorno, "Modern Wiener-Hopf design of optimal controllers—Part II: The multivariable case," *IEEE Trans., Autom. Contr.*, vol 21, no. 3, pp. 319–338, 1976.

[9] G. Meinsma, "On the Standard H_2-Problem", Proc. Third IFAC Symposium on Robust Control Design. Prague, June 21-23, 2000.

[10] E.I. Veremey, "Algorithms for Solving a Class of Problems of H_∞-optimization of Control Systems," *J. of Comput. and Syst. Sci. Int.*, vol. 50, no 3, pp. 403 – 412, 2011.