Structured Sylvester and T-Sylvester equations

Ivana Kuzmanović
Department of Mathematics,
J. J. Strossmayer University of Osijek
ikuzmano@mathos.hr

Sylvester and T-Sylvester[1] equations are matrix equations of the form $AX + XB = E$ and $AX + X^T B = E$, respectively, where A, B and E are given and X is unknown matrix.

Sylvester equations appear frequently in many areas of applied mathematics. For example, Sylvester equations play vital roles in matrix eigen-decompositions, control theory, model reduction, numerical solution of matrix differential Riccati equations and algebraic Riccati equation, image processing, and many more. On the other hand, T-Sylvester matrix equations have recently attracted attention of researchers because of their relationship with palindromic eigenvalue problems.

This talk will be focused on structured Sylvester and T- Sylvester equations, especially on structured problems with system matrices of the form $A = A_0 + U_1V_1$ and $B = B_0 + U_2V_2$ where U_1, U_2, V_1, V_2 are small rank update matrices. Sherman-Morrison-Woodbury-type formula for the solutions of this type of equations will be given. The obtained formula is used for the construction of an algorithm that solves the equations of the above form much more efficiently than the standard algorithms. Application of obtained algorithms will be illustrated in several examples.

[1] T-Sylvester equation is also known as Sylvester equation for T-congruence