Time-Varying Matrix Problems and Zhang Neural Networks

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From joint work with

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Abstract : We adapt convergent look-ahead and backward finite difference formulas to compute future eigenvectors and eigenvalues of piecewise smooth time-varying matrix flows $A(t)$. This is based on the Zhang Neural Network model for time-varying problems and uses the associated error function

$$E(t) = A(t)V(t) - V(t)D(t)$$

with the Zhang design stipulation for rapid error decay

$$\dot{E}(t) = -\eta E(t)\ .$$

Here $E(t)$ decreased exponentially over time for $\eta \gg 1$. It leads to a discrete-time differential equation of the form $P(t_k)\dot{z}(t_k) = q(t_k)$ for the eigendata vector $z(t_k)$ of $A(t_k)$. Convergent high order look-ahead difference formulas then allow us to express $z(t_{k+1})$ in terms of earlier discrete A and z data. Numerical tests, comparisons and open questions follow.

Subject Classifications : 65H17, 65L12, 65F15, 65Q10, 92B20

Key Words : time-varying matrix eigenvalues, matrix computations, Zhang Neural Network, look-ahead discretization formula, error function, numerical analysis, numerical linear algebra, real-time computations