Chapter 12

Conclusions

- Area of applications.
- Relation to discrete methods.
- Challenge to ODE techniques.
- More to do.

Area of Applications

- Numerical analysis:
  - ◇ Eigenvalue computation.
  - ◇ Singular value computation.
  - ◇ Construction of balanced realizations.
  - ◇ Inverse spectrum problems.
- Matrix theory:
  - ◇ Existence question.
  - ◇ Nearness problems.
- Mechanics:
  - ◇ Mechanical system simulation.
  - ◇ Structure analysis.
  - ◇ Multibody oscillation.
- Control theory:
  - ◇ State or output feedback pole assignment problem.
  - ◇ Multivariable system identification.

- Signal processing.
  - ◇ Molecular spectroscopy.
  - ◇ Antenna array processing.
  - ◇ Seismic tomography.
- Multivariate statistical analysis:
  - ◇ Principal component analysis.
- Mathematical programming.
  - ◇ Interior point method for linear programming.
  - ◇ Quadratic assignment problem.

Relation to Discrete Methods

- Offer critical insights into the understanding of the dynamics of discrete methods.
  - ◇ QR algorithm.
  - ◇ SVD algorithm.
  - ◇ Jacobi algorithm.
- Unify a variety of discrete methods as special cases of different discretization.
  - ◇ QR-type flow.
  - ◇ Spectrally constrained flow.
- Give rise to the design of new numerical algorithms
  - ◇ Difference methods resulted from discretization of differential systems.
  - ◇ Geometric methods resulted from the underlying topology.

Challenge to ODE Techniques

- May be used as benchmark problems for testing new ODE techniques.
  - ◇ Large scale computation — Size grows as n^2.
- New ODE techniques may further benefit the numerical computation.
  - ◇ Parallel ODE methods (Burrage, '95).

More to Do

- Enable to tackle existence problems that are seemingly impossible to be solved by conventional discrete methods.
  - ◇ Inverse eigenvalue problems.
- Usually offers a global method for solving the underlying problem.
- Analog realization:
  - ◇ Cheap and fast.
  - ◇ Discrete counterparts may not be easy to find.
  - ◇ Suffers from limited accuracy.