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Refactored Bi-Iteration: A High Performance Eigensolution Method for Large Power System Matrices

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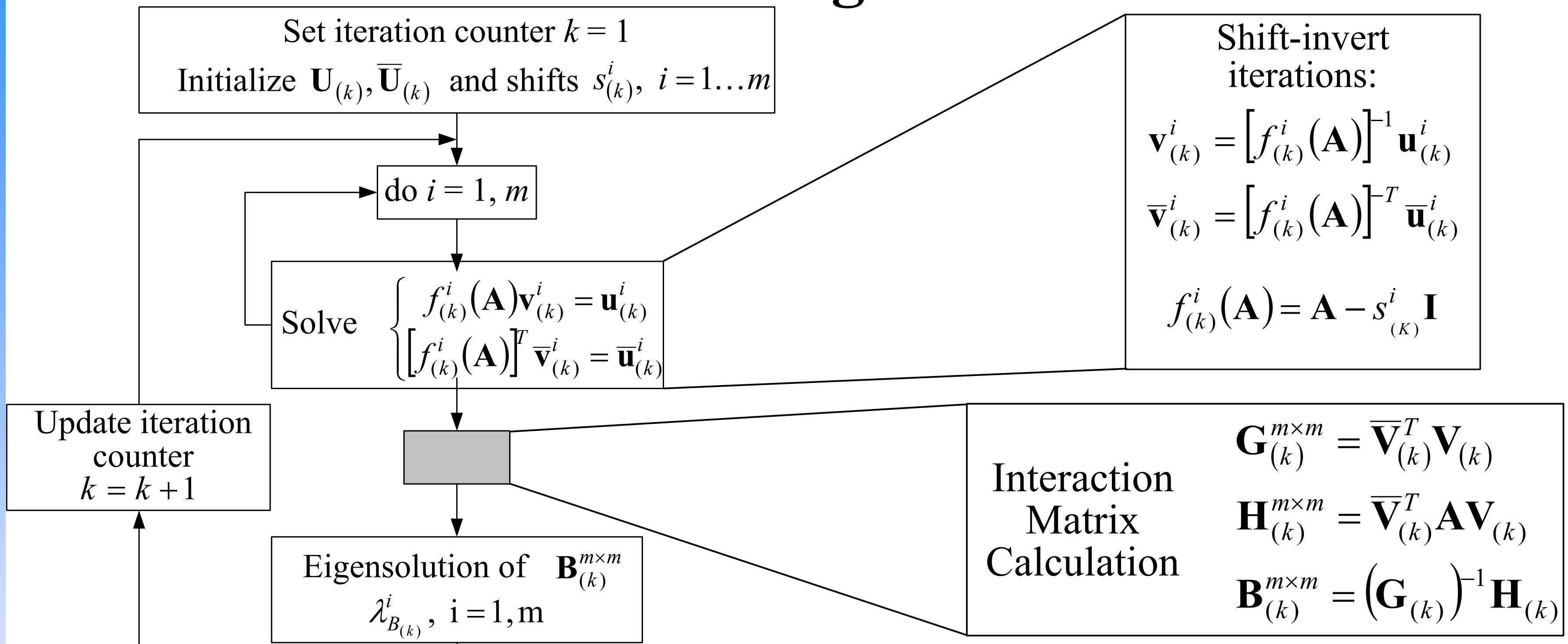
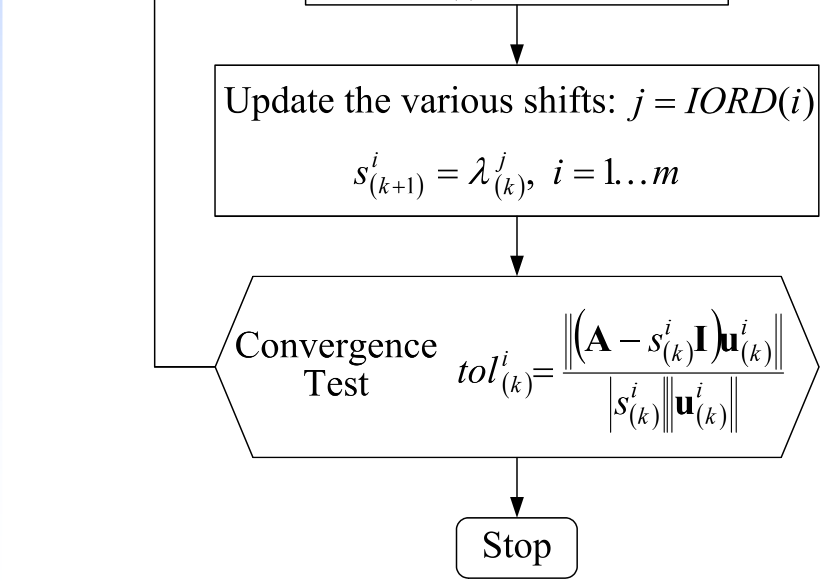
The RBI Algorithm





- Re-orthogonalizing the updated eigenvector estimates is not cost-effective since shifts dominate the process

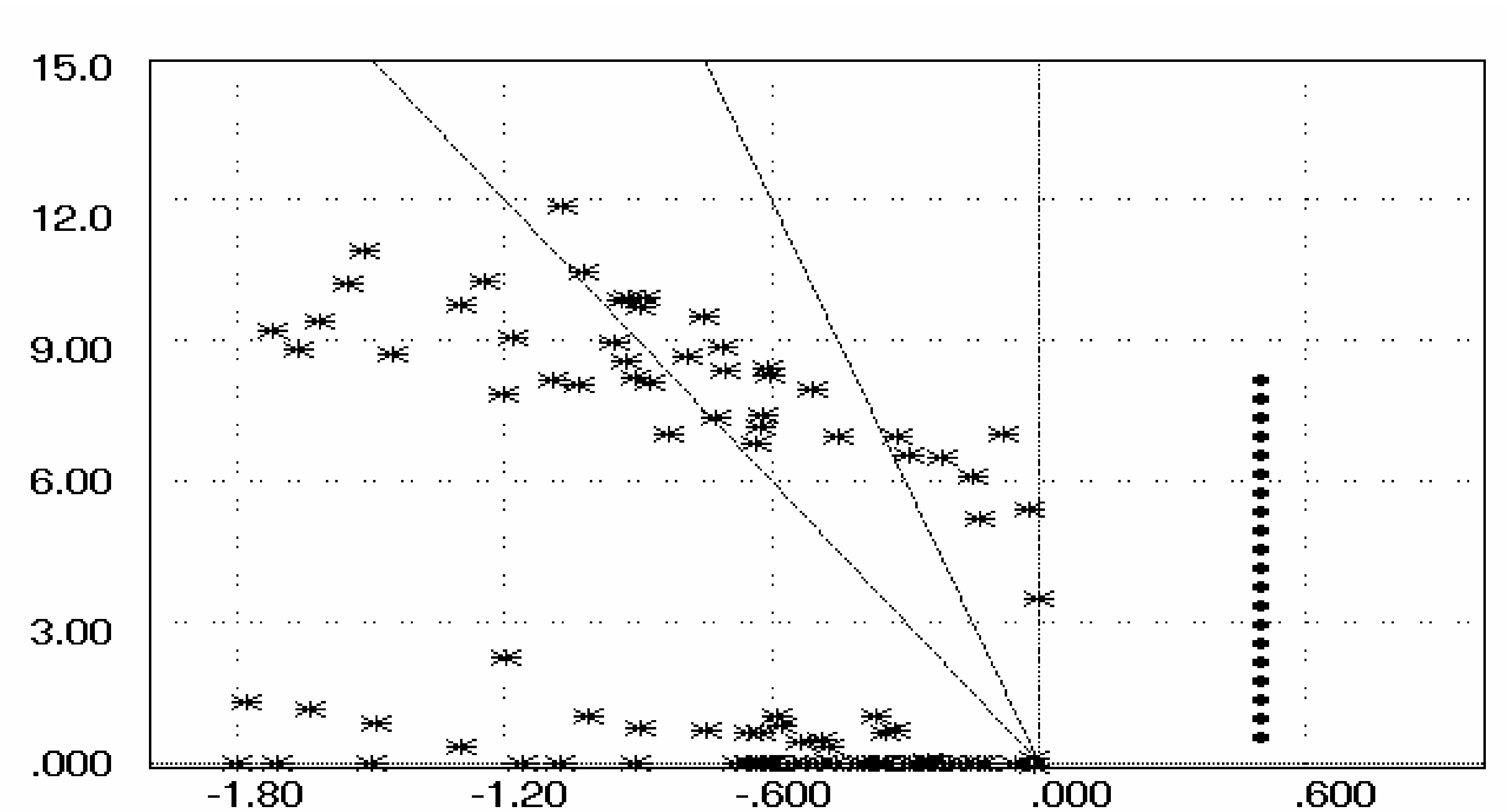
- Updated shifts must be reordered appropriately: $j = IORD(i)$

RBI Results on the South-Southeast Brazilian System (1986 Operations Planning Model)

- 616-Bus, 50-Generator Model, with no PSSs
- 362 State Variables
- 8 Poorly-Damped Electromechanical Modes
- Objective here is to determine the least-damped and unstable electromechanical modes using sparse, partial eigensolution algorithms

RBI Results for the 362-State Matrix

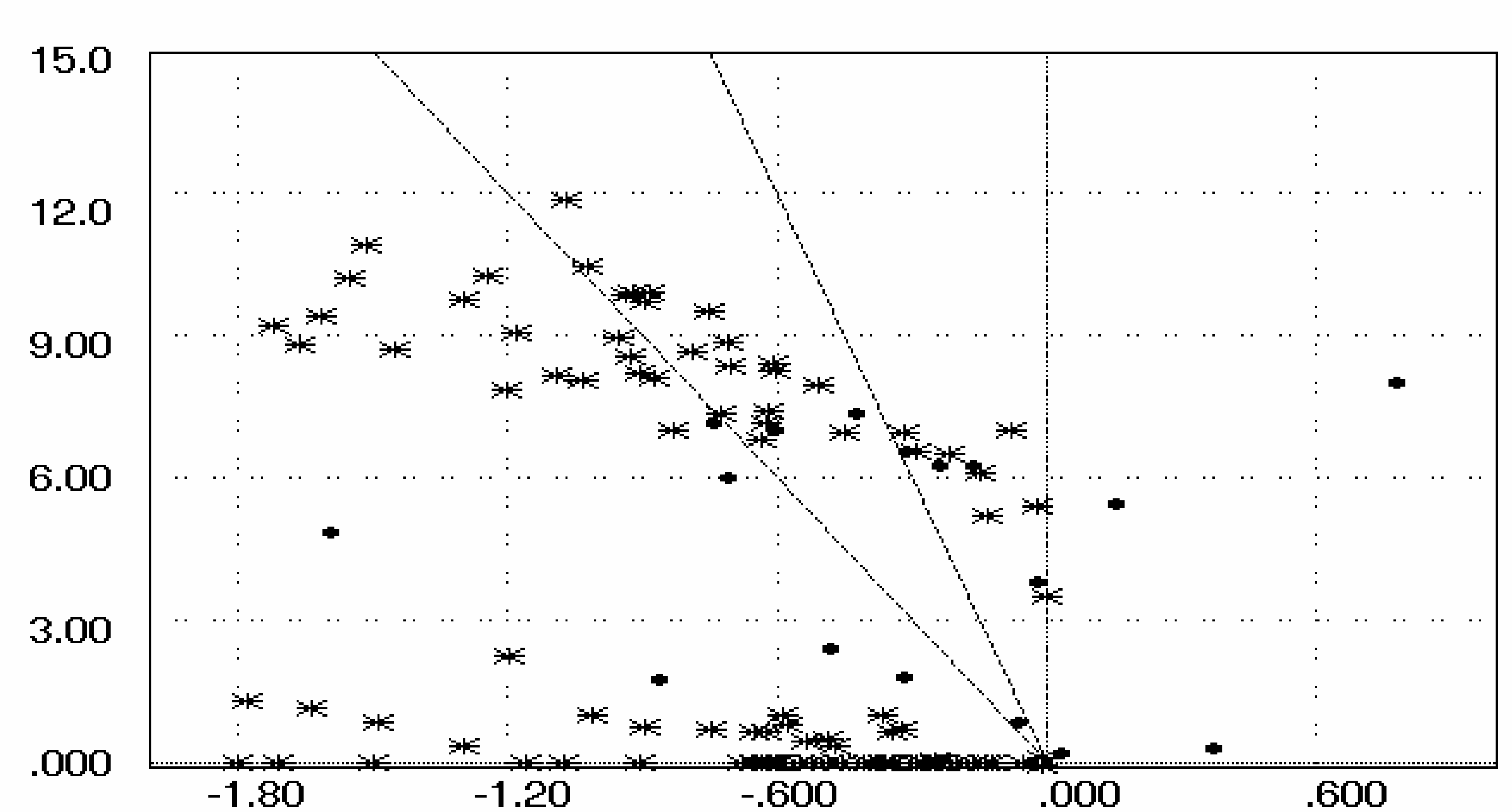
Convergence Demo 1/5



- Full system eigenvalues shown by asterisks
- Initial shifts (20) shown as black circles

RBI Results for the 362-State Matrix

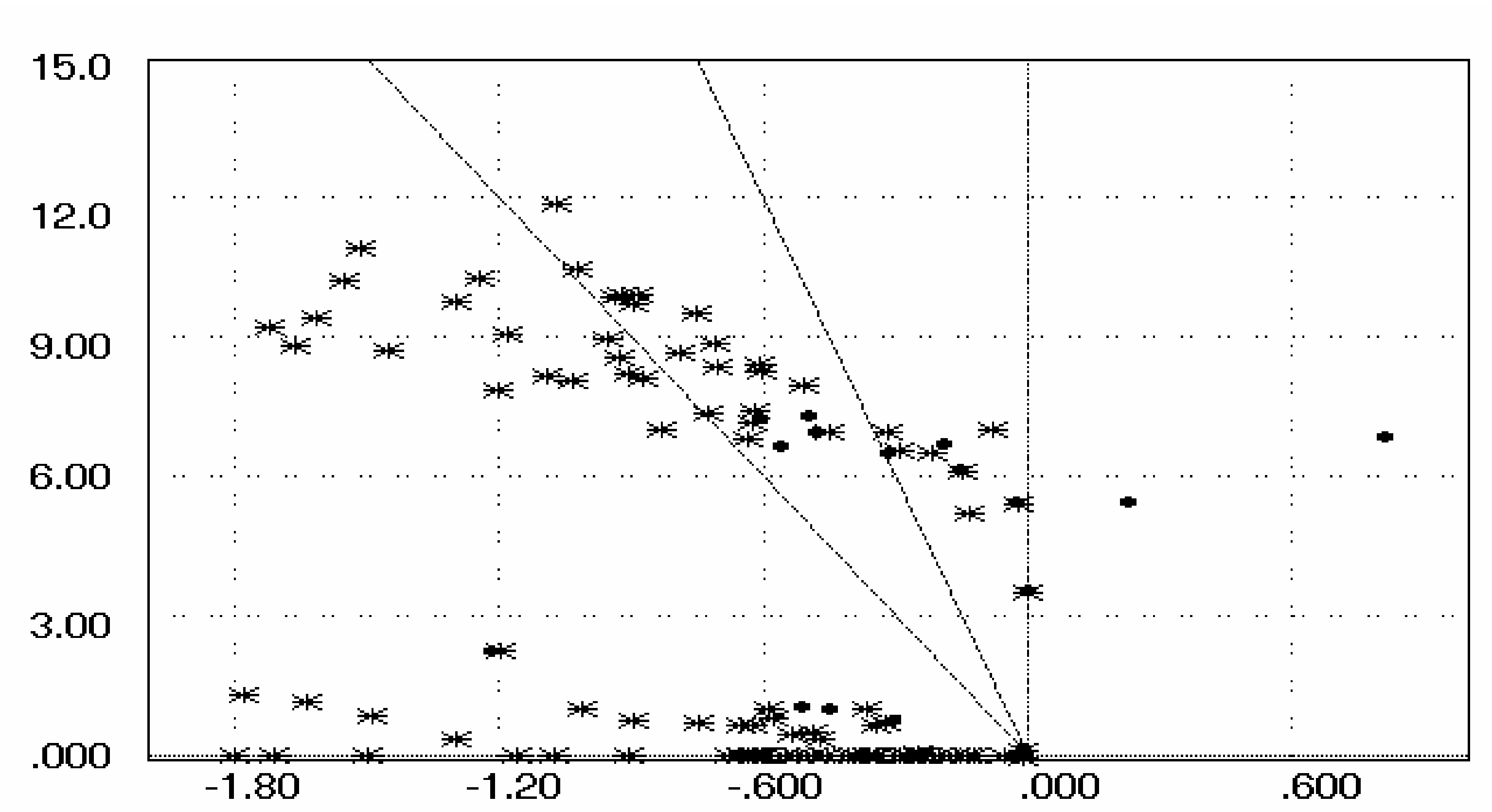
Convergence Demo 2/5



- Full system eigenvalues shown by asterisks
- Moving shifts after first iteration shown by black circles

RBI Results for the 362-State Matrix

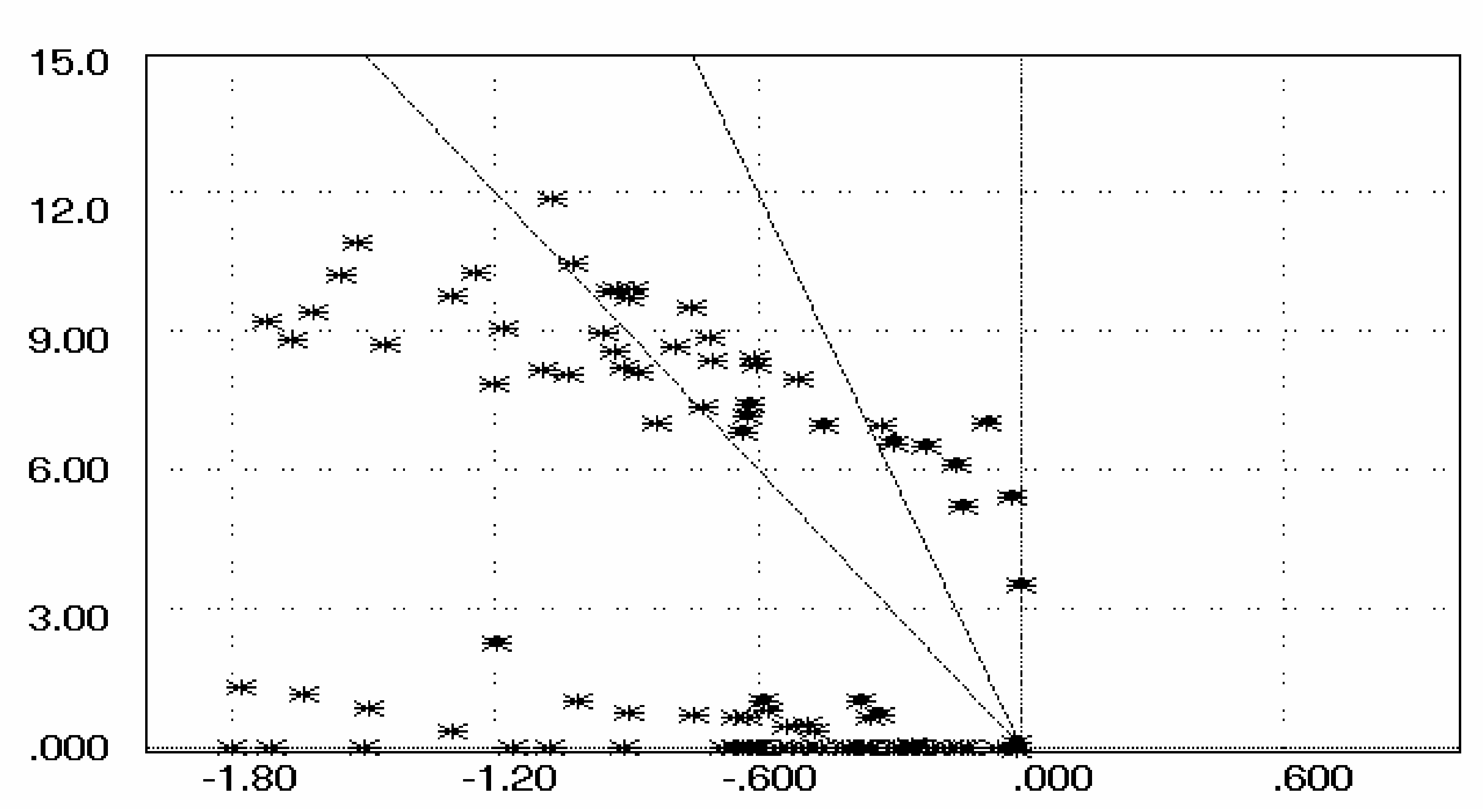
Convergence Demo 3/5



- Full system eigenvalues shown by asterisks
- Moving shifts after second iteration shown by black circles

RBI Results for the 362-State Matrix

Convergence Demo 4/5

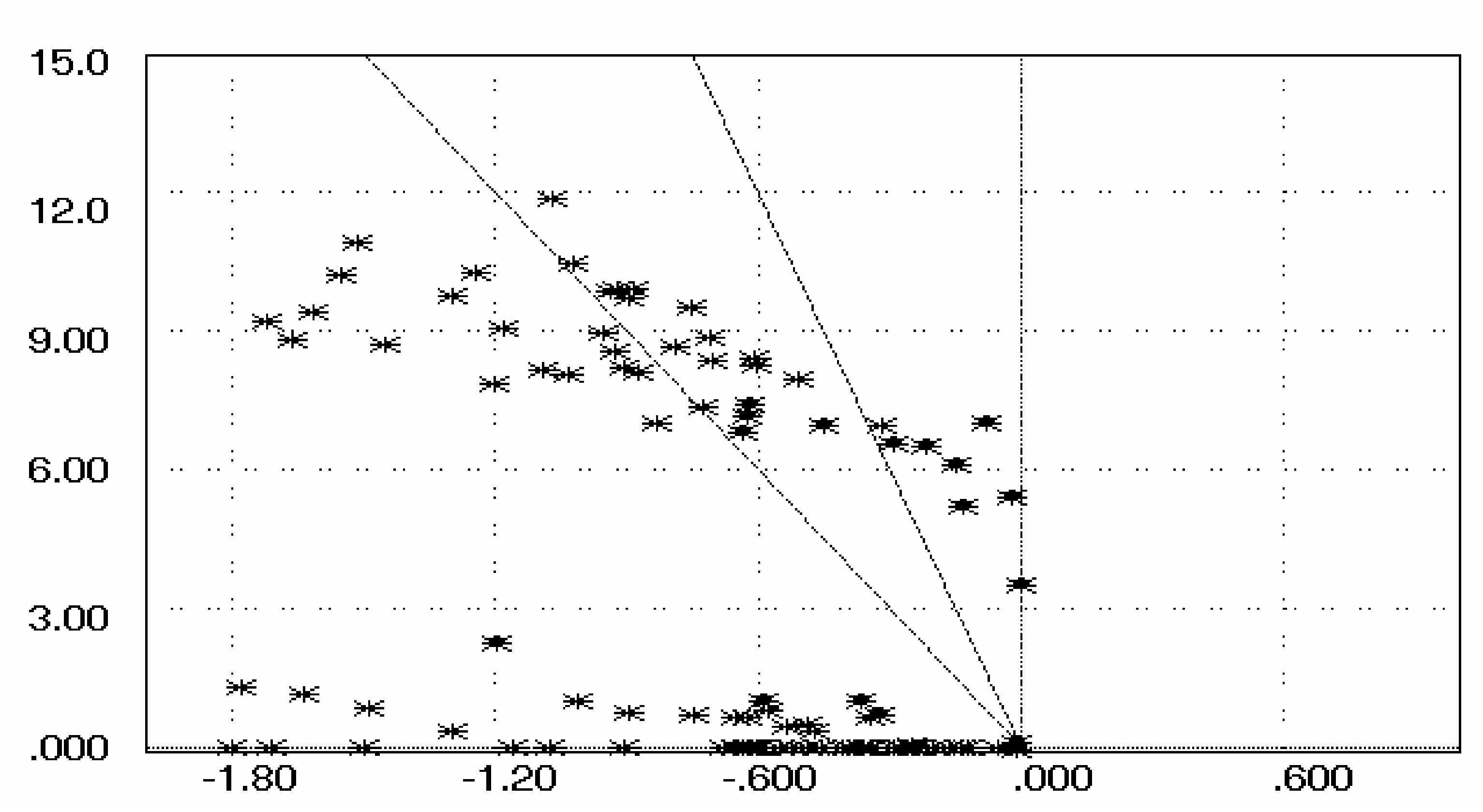


•Full system eigenvalues shown by asterisks

•Moving shifts after third iteration shown by black circles

RBI Results for the 362-State Matrix

Convergence Demo 5/5



•Full system eigenvalues shown by asterisks

•Moving shifts after fourth iteration shown by black circles

Conclusions (1/2)

- The Refactored Bi-Iteration algorithm (RBI) operates on the state-space or the sparser descriptor system models of large dynamic systems

- All 20 eigensolutions of the 362-state matrix were obtained in 5 iterations. Convergence tolerance adopted was 1.0 e-10

- Seven out of the eight least-damped modes were obtained in the first run. Another run with similar set of shifts, deflating the already obtained left-right subspace, will find the only low damped eigenvalue that was missing in the first run solution

- RBI has shown fast and robust performance for the test system utilized, as well as for many other systems of much larger sizes

Conclusions (2/2)

- RBI simultaneously performs several Rayleigh Quotient eigensolution processes, whose right/left subspaces of eigenvector estimates are re-orthogonalized at every iteration
- RBI has global convergence characteristics and converges to eigenvalues that are nearest to the initial shifts
- Repeated solutions are not produced
- RBI may be used with matrix functionals other than Shift-Invert, such as Moebius Transforms