PIES Code Modifications to Improve Code Speed

Don Monticello, Allan Reiman,
Alex Pletzer, and Michael Drevlak

Outline

- PIES Ported to IPP SX5 vector Machine
- New Blending Algorithm for PIES
- Improved PIES Poisson Solver
- Implementation of Splines in PIES
- Summary
- Future Plans

PIES Ported to IPP SX5 vector Machine

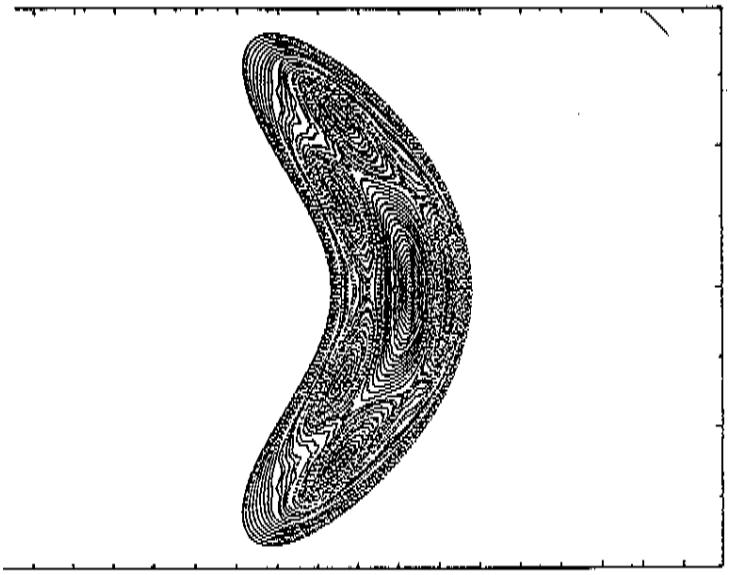
- The PIES code has been successfully ported to the IPP SX5 vector machine.
- The PIES code has been optimized for the SX5 (about a factor of 25%).
- Running the PIES Code on he SX5 is about 12 times faster than Killeen. Runs for C82 with dimension of 65,32,12 (k,m,n) takes about .4 hours per iteration on SX5 and about 5 hours per iteration on Killeen.

New Blending Algorithm for PIES

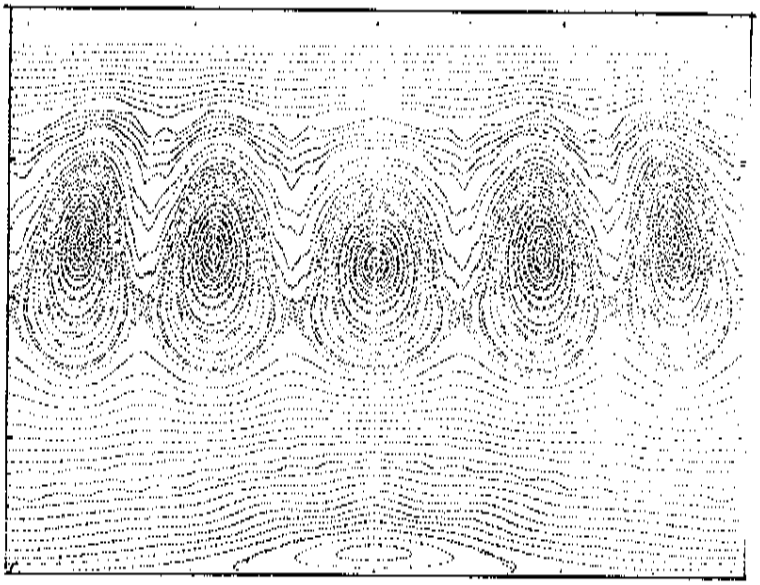
- A new blending algorithm has been implemented in PIES. Blending is now done on the magnetic fields rather than the currents.
- This new algorithm is more stable and more reliable. Equilibrium solutions are reached more rapidly. More of the new fields can be used on each iteration than in the old blending algorithm.

ITERATION 1

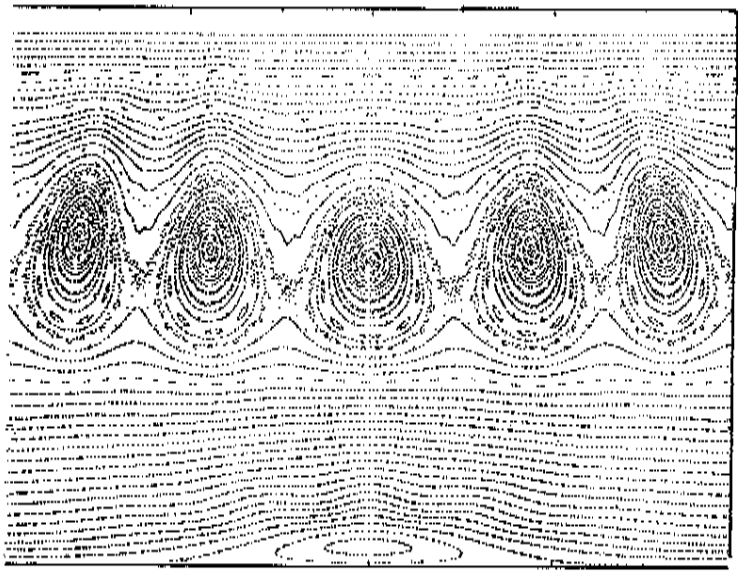
REAL SPACE



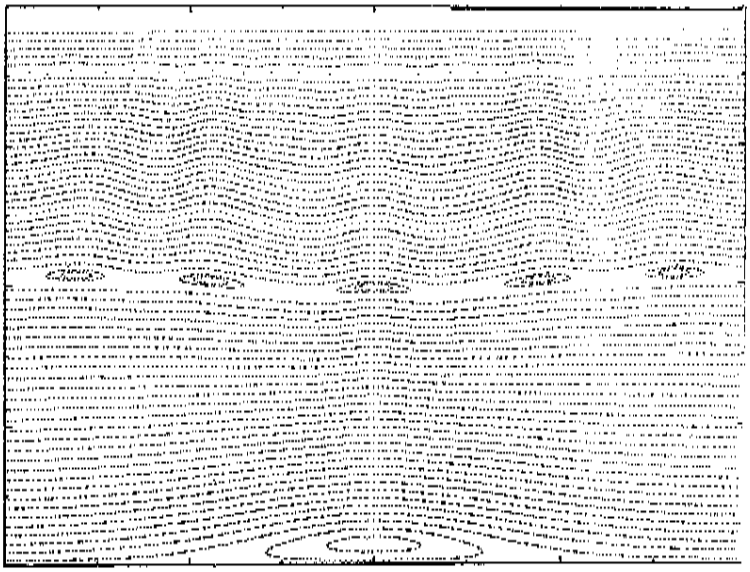
BACKGROUND COORDINATES



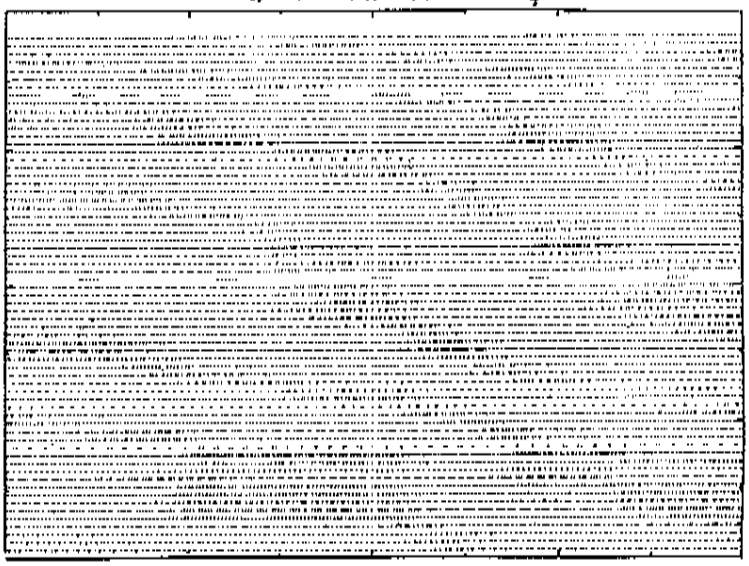
ITERATION 10

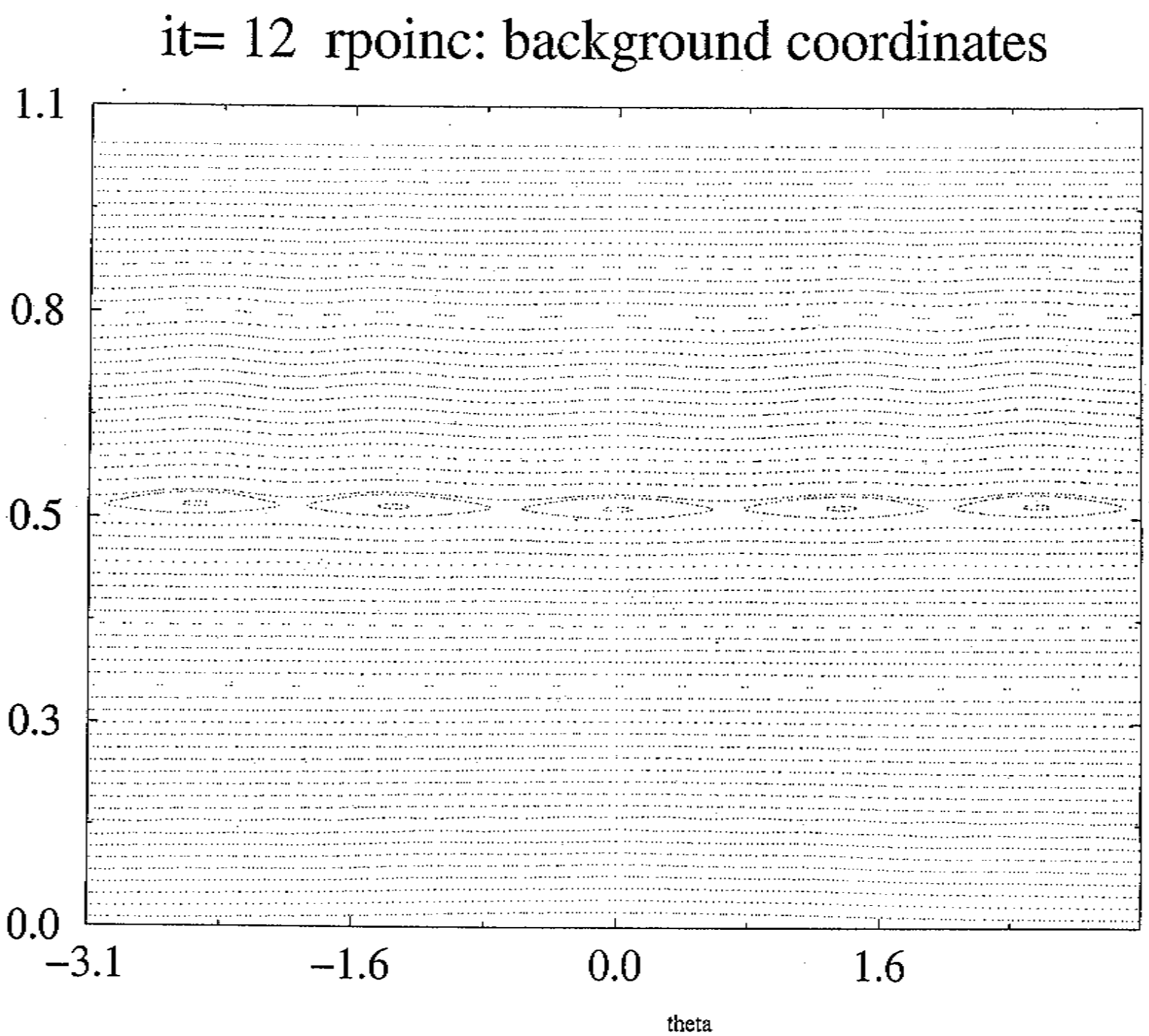


ITERATION 300

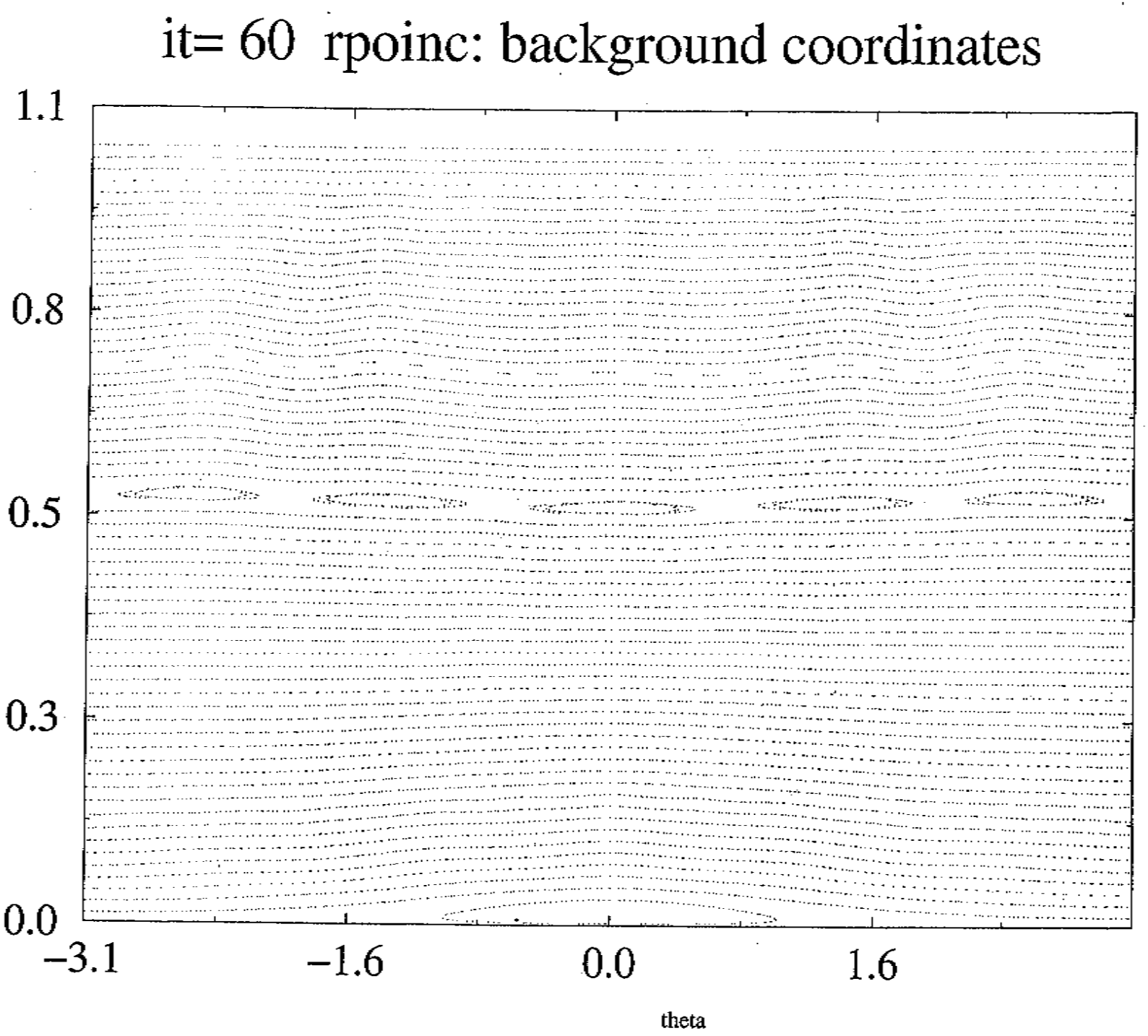


ITERATION ϕ





it= 12 rpoinc: background coordinates



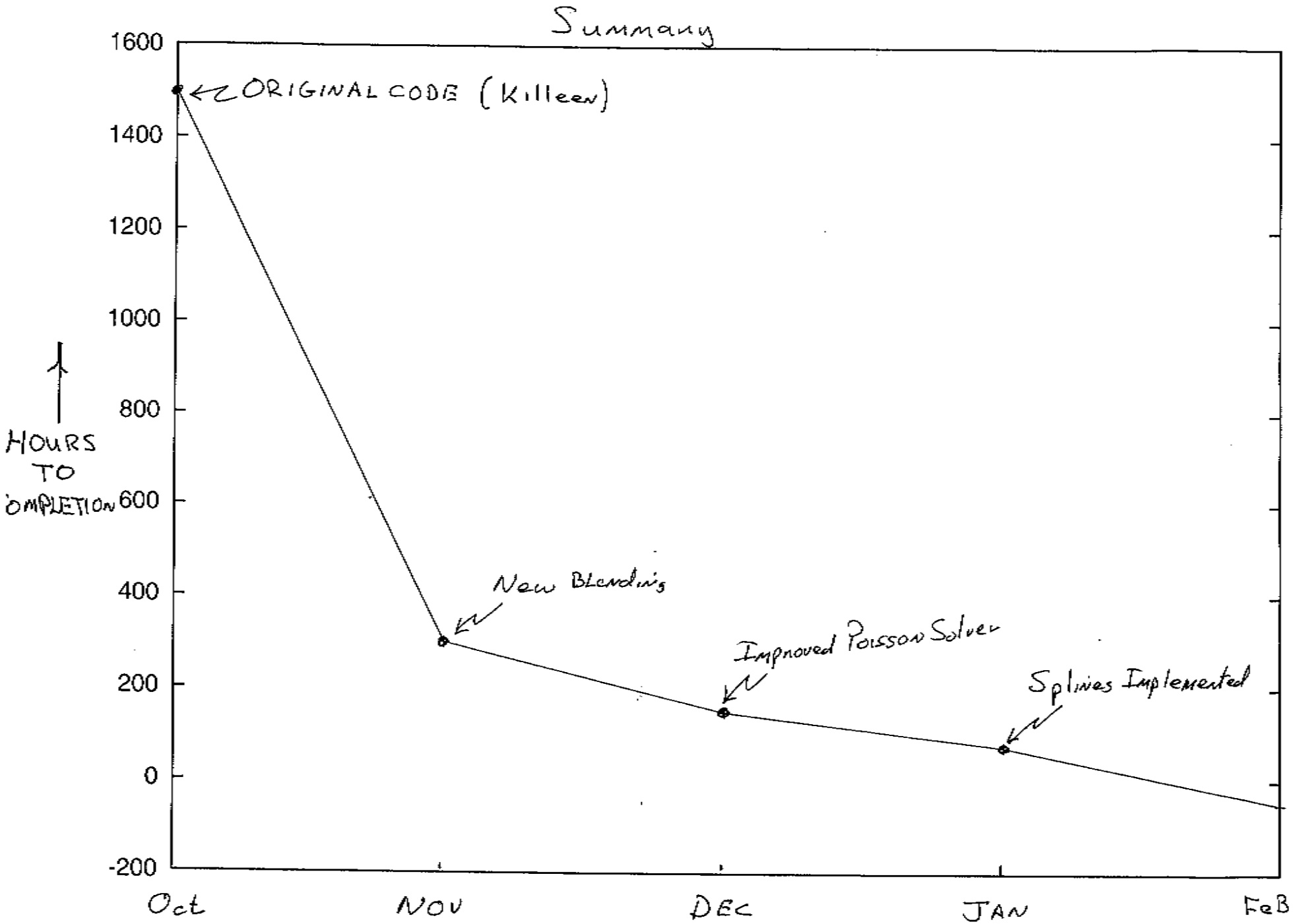
it= 60 rpoinc: background coordinates

Improved PIES Poisson Solver

- In large PIES runs, the Poisson solve for the magnetic field, given the currents, takes about 50% of the computer time.
- We have speed up the Poisson solver by about 50. Thus, the overall speed of the code has been improved by a factor of 2.

Implementation of Splines in PIES

- In large PIES runs, the following of field lines takes about 60% of the computer time (assuming the new Poisson solver is being used).
- In place of a Fourier series representation, we have implemented Doug McCune's three-dimensional splines to represent the magntic fields. This has lead to a factor of 4 increase in the speed of the field line following part of the code. Splines, have thus lead to about factor of 2 increase in speed.


Summary
1600
1400
1200
1000
800
600
400
200
0
-200
HOURS TO COMPLETION
ORIGINAL CODE (Killeen)
New Blending
Improved Poisson Solver
Splines Implemented
Oct
NOV
DEC
JAN
FeB

Future Plans

- Improvement Treatment of Free Boundary scheme
- Implementation of Neoclassical Bootstrap Effects
- Benchmarking with VMEC and M3D