

APPENDIX I: GMRES Parameter Study

TOLERANCE

N=128

Updated Preconditioner GMRES version of ode15s

314 successful steps

93 failed attempts

1079 function evaluations

39 partial derivatives

0 LU decompositions

801 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 117.701299 with 1110 GMRES iterates

Tolerance was 0.100000

Restart Value was 10

Max Iters Value was 10

Fail/Success Ratio of 0.296178

J-Evals per step of 0.124204

F-Evals per step of 3.436306

Linear Solves per step of 2.550955

GMRES iterates per step of 3.535032

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

251 successful steps

55 failed attempts

861 function evaluations

40 partial derivatives

0 LU decompositions

576 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 135.150369 with 2235 GMRES iterates

Tolerance was 0.010000

Restart Value was 10

Max Iters Value was 10

Fail/Success Ratio of 0.219124

J-Evals per step of 0.159363

F-Evals per step of 3.430279

Linear Solves per step of 2.294821

GMRES iterates per step of 8.904382

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
231 successful steps
42 failed attempts
719 function evaluations
32 partial derivatives
0 LU decompositions
490 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 146.521627 with 2360 GMRES iterates
Tolerance was 0.001000
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.181818
J-Evals per step of 0.138528
F-Evals per step of 3.112554
Linear Solves per step of 2.121212
GMRES iterates per step of 10.216450

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
213 successful steps
25 failed attempts
554 function evaluations
20 partial derivatives
0 LU decompositions
409 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 175.362529 with 2116 GMRES iterates
Tolerance was 0.000100
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.117371
J-Evals per step of 0.093897
F-Evals per step of 2.600939
Linear Solves per step of 1.920188
GMRES iterates per step of 9.934272

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s

207 successful steps
20 failed attempts
495 function evaluations
16 partial derivatives
0 LU decompositions
378 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 227.029526 with 1970 GMRES iterates
Tolerance was 0.000010
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.096618
J-Evals per step of 0.077295
F-Evals per step of 2.391304
Linear Solves per step of 1.826087
GMRES iterates per step of 9.516908

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 246.057617 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
225 successful steps
36 failed attempts
671 function evaluations

29 partial derivatives
0 LU decompositions
463 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 550.033341 with 2867 GMRES iterates
Tolerance was 0.000000
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.160000
J-Evals per step of 0.128889
F-Evals per step of 2.982222
Linear Solves per step of 2.057778
GMRES iterates per step of 12.742222

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
207 successful steps
17 failed attempts
456 function evaluations
13 partial derivatives
0 LU decompositions
360 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 271.537186 with 2406 GMRES iterates
Tolerance was 0.000000
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.082126
J-Evals per step of 0.062802
F-Evals per step of 2.202899
Linear Solves per step of 1.739130
GMRES iterates per step of 11.623188

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
233 successful steps
45 failed attempts
737 function evaluations
35 partial derivatives
0 LU decompositions
487 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 637.263694 with 3208 GMRES iterates
Tolerance was 0.000000
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.193133
J-Evals per step of 0.150215
F-Evals per step of 3.163090
Linear Solves per step of 2.090129
GMRES iterates per step of 13.768240

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s
207 successful steps
19 failed attempts
483 function evaluations
15 partial derivatives
0 LU decompositions
373 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 449.763870 with 2253 GMRES iterates
Tolerance was 0.000000
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.091787
J-Evals per step of 0.072464
F-Evals per step of 2.333333
Linear Solves per step of 1.801932
GMRES iterates per step of 10.884058

Run of size 128 complete

RESTART

N=128

Updated Preconditioner GMRES version of ode15s
227 successful steps
37 failed attempts
657 function evaluations
28 partial derivatives
0 LU decompositions
456 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 225.396476 with 455 GMRES iterates

Tolerance was 0.000001
Restart Value was 1
Max Iters Value was 10
Fail/Success Ratio of 0.162996
J-Evals per step of 0.123348
F-Evals per step of 2.894273
Linear Solves per step of 2.008811
GMRES iterates per step of 2.004405

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

226 successful steps

38 failed attempts

668 function evaluations

29 partial derivatives

0 LU decompositions

460 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 269.004473 with 853 GMRES iterates

Tolerance was 0.000001

Restart Value was 2

Max Iters Value was 10

Fail/Success Ratio of 0.168142

J-Evals per step of 0.128319

F-Evals per step of 2.955752

Linear Solves per step of 2.035398

GMRES iterates per step of 3.774336

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

251 successful steps

65 failed attempts

907 function evaluations

48 partial derivatives

0 LU decompositions

566 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 453.095709 with 1561 GMRES iterates

Tolerance was 0.000001

Restart Value was 3

Max Iters Value was 10

Fail/Success Ratio of 0.258964
J-Evals per step of 0.191235
F-Evals per step of 3.613546
Linear Solves per step of 2.254980
GMRES iterates per step of 6.219124

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

208 successful steps

24 failed attempts

531 function evaluations

19 partial derivatives

0 LU decompositions

393 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 242.935910 with 962 GMRES iterates

Tolerance was 0.000001

Restart Value was 4

Max Iters Value was 10

Fail/Success Ratio of 0.115385

J-Evals per step of 0.091346

F-Evals per step of 2.552885

Linear Solves per step of 1.889423

GMRES iterates per step of 4.625000

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

233 successful steps

39 failed attempts

684 function evaluations

30 partial derivatives

0 LU decompositions

469 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 309.912998 with 1087 GMRES iterates

Tolerance was 0.000001

Restart Value was 5

Max Iters Value was 10

Fail/Success Ratio of 0.167382

J-Evals per step of 0.128755

F-Evals per step of 2.935622

Linear Solves per step of 2.012876
GMRES iterates per step of 4.665236

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

246 successful steps

51 failed attempts

811 function evaluations

38 partial derivatives

0 LU decompositions

540 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 403.633216 with 2259 GMRES iterates

Tolerance was 0.000001

Restart Value was 6

Max Iters Value was 10

Fail/Success Ratio of 0.207317

J-Evals per step of 0.154472

F-Evals per step of 3.296748

Linear Solves per step of 2.195122

GMRES iterates per step of 9.182927

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

212 successful steps

22 failed attempts

510 function evaluations

17 partial derivatives

0 LU decompositions

386 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 281.307864 with 1818 GMRES iterates

Tolerance was 0.000001

Restart Value was 7

Max Iters Value was 10

Fail/Success Ratio of 0.103774

J-Evals per step of 0.080189

F-Evals per step of 2.405660

Linear Solves per step of 1.820755

GMRES iterates per step of 8.575472

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

212 successful steps

22 failed attempts

510 function evaluations

17 partial derivatives

0 LU decompositions

386 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 241.135959 with 1946 GMRES iterates

Tolerance was 0.000001

Restart Value was 8

Max Iters Value was 10

Fail/Success Ratio of 0.103774

J-Evals per step of 0.080189

F-Evals per step of 2.405660

Linear Solves per step of 1.820755

GMRES iterates per step of 9.179245

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

212 successful steps

22 failed attempts

510 function evaluations

17 partial derivatives

0 LU decompositions

386 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 236.981114 with 2082 GMRES iterates

Tolerance was 0.000001

Restart Value was 9

Max Iters Value was 10

Fail/Success Ratio of 0.103774

J-Evals per step of 0.080189

F-Evals per step of 2.405660

Linear Solves per step of 1.820755

GMRES iterates per step of 9.820755

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 244.331942 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 193.821828 with 5262 GMRES iterates
Fail/Success Ratio of 0.094017
J-Evals per step of 0.072650
F-Evals per step of 2.179487
Linear Solves per step of 1.649573
GMRES iterates per step of 22.487179
GMRES iterates per solve of 13.632124
Tolerance was 0.000001
Restart Value was 15
Max Iters Value was 10
Proportion of Failures was 0.000000

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps

22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 220.961693 with 4946 GMRES iterates
Fail/Success Ratio of 0.094017
J-Evals per step of 0.072650
F-Evals per step of 2.179487
Linear Solves per step of 1.649573
GMRES iterates per step of 21.136752
GMRES iterates per solve of 12.813472
Tolerance was 0.000001
Restart Value was 30
Max Iters Value was 10
Proportion of Failures was 0.000000

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 236.547107 with 4788 GMRES iterates
Fail/Success Ratio of 0.094017
J-Evals per step of 0.072650
F-Evals per step of 2.179487
Linear Solves per step of 1.649573
GMRES iterates per step of 20.461538
GMRES iterates per solve of 12.404145
Tolerance was 0.000001
Restart Value was 45
Max Iters Value was 10
Proportion of Failures was 0.000000

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s

212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 366.141697 with 4770 GMRES iterates
Fail/Success Ratio of 0.094017
J-Evals per step of 0.072650
F-Evals per step of 2.179487
Linear Solves per step of 1.649573
GMRES iterates per step of 20.384615
GMRES iterates per solve of 12.357513
Tolerance was 0.000001
Restart Value was 60
Max Iters Value was 10
Proportion of Failures was 0.000000

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 240.151578 with 4755 GMRES iterates
Fail/Success Ratio of 0.094017
J-Evals per step of 0.072650
F-Evals per step of 2.179487
Linear Solves per step of 1.649573
GMRES iterates per step of 20.320513
GMRES iterates per solve of 12.318653
Tolerance was 0.000001
Restart Value was 75
Max Iters Value was 10
Proportion of Failures was 0.000000

Run of size 128 complete

MAXIMUM ITERATIONS

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 241.339120 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 10
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 240.551120 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 20
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s

212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 238.050222 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 30
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 240.912704 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 40
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations

17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 239.437258 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 50
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 243.650618 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 60
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 238.925048 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 70
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 237.655957 with 2124 GMRES iterates
Tolerance was 0.000001
Restart Value was 10
Max Iters Value was 80
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128
Updated Preconditioner GMRES version of ode15s
212 successful steps
22 failed attempts
510 function evaluations
17 partial derivatives
0 LU decompositions
386 solutions of linear systems
Updated Preconditioner GMRES finished, final time was 245.551476 with 2124 GMRES iterates
Tolerance was 0.000001

Restart Value was 10
Max Iters Value was 90
Fail/Success Ratio of 0.103774
J-Evals per step of 0.080189
F-Evals per step of 2.405660
Linear Solves per step of 1.820755
GMRES iterates per step of 10.018868

Run of size 128 complete

N=128

Updated Preconditioner GMRES version of ode15s

212 successful steps

22 failed attempts

510 function evaluations

17 partial derivatives

0 LU decompositions

386 solutions of linear systems

Updated Preconditioner GMRES finished, final time was 242.660955 with 2124 GMRES iterates

Tolerance was 0.000001

Restart Value was 10

Max Iters Value was 100

Fail/Success Ratio of 0.103774

J-Evals per step of 0.080189

F-Evals per step of 2.405660

Linear Solves per step of 1.820755

GMRES iterates per step of 10.018868

Run of size 128 complete