

Raport IGA-ADS

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1. Informacje o Systemie

Specyfikacja Sprzętu

Procesor: Apple M3 Pro **Pamięć:** 18 GB **Rdzenie:** 11 (5 performance and 6 efficiency)

System Operacyjny

System: macOS 26.0.1 **Architektura:** arm64

2. Log z Instalacji

Środowisko Docker (Ubuntu 24.04.3 LTS)

CMake: cmake version 3.28.3 **Gfortran:** GNU Fortran (Ubuntu 13.3.0-6ubuntu2~24.04) 13.3.0 **Boost:** 1.83.0.1ubuntu2 **BLAS:** 3.12.0-3build1.1 **LAPACK:** 3.12.0-3build1.1

3. Log z Wywołania CMake

Komenda Konfiguracyjna

```
1  cmake -S . -B build -D CMAKE_BUILD_TYPE=Release -D ADS_USE_GALOIS=ON -D USE_MUMPS=OFF -D ↵  
↵CMAKE_PREFIX_PATH="${DEPS}"
```

Wynik Konfiguracji

```
1  -- The CXX compiler identification is GNU 13.3.0  
2  -- Detecting CXX compiler ABI info  
3  -- Detecting CXX compiler ABI info - done  
4  -- Check for working CXX compiler: /usr/bin/c++ - skipped  
5  -- Detecting CXX compile features  
6  -- Detecting CXX compile features - done  
7  -- Performing Test ADS_CXX_SUPPORTS_-Wall  
8  -- Performing Test ADS_CXX_SUPPORTS_-Wall - Success  
9  -- Performing Test ADS_CXX_SUPPORTS_-Wextra  
10 -- Performing Test ADS_CXX_SUPPORTS_-Wextra - Success  
11 -- Performing Test ADS_CXX_SUPPORTS_-Wpedantic  
12 -- Performing Test ADS_CXX_SUPPORTS_-Wpedantic - Success  
13 -- Performing Test ADS_CXX_SUPPORTS_-Wunused  
14 -- Performing Test ADS_CXX_SUPPORTS_-Wunused - Success  
15 -- Performing Test ADS_CXX_SUPPORTS_-Wnon-virtual-dtor  
16 -- Performing Test ADS_CXX_SUPPORTS_-Wnon-virtual-dtor - Success  
17 -- Performing Test ADS_CXX_SUPPORTS_-Woverloaded-virtual  
18 -- Performing Test ADS_CXX_SUPPORTS_-Woverloaded-virtual - Success  
19 -- Performing Test ADS_CXX_SUPPORTS_-Wmisleading-indentation  
20 -- Performing Test ADS_CXX_SUPPORTS_-Wmisleading-indentation - Success  
21 -- Performing Test ADS_CXX_SUPPORTS_-Wfloat-conversion  
22 -- Performing Test ADS_CXX_SUPPORTS_-Wfloat-conversion - Success  
23 -- Performing Test ADS_CXX_SUPPORTS_-Wold-style-cast  
24 -- Performing Test ADS_CXX_SUPPORTS_-Wold-style-cast - Success  
25 -- Performing Test ADS_CXX_SUPPORTS_-Wcast-align  
26 -- Performing Test ADS_CXX_SUPPORTS_-Wcast-align - Success  
27 -- Performing Test ADS_CXX_SUPPORTS_-Wconversion
```

```

28 -- Performing Test ADS_CXX_SUPPORTS_-Wconversion - Success
29 -- Performing Test ADS_CXX_SUPPORTS_-Wsuggest-override
30 -- Performing Test ADS_CXX_SUPPORTS_-Wsuggest-override - Success
31 -- Performing Test ADS_CXX_SUPPORTS_-Wlogical-op
32 -- Performing Test ADS_CXX_SUPPORTS_-Wlogical-op - Success
33 -- Performing Test ADS_CXX_SUPPORTS_-Wuseless-cast
34 -- Performing Test ADS_CXX_SUPPORTS_-Wuseless-cast - Success
35 -- Performing Test ADS_CXX_SUPPORTS_-Wduplicated-cond
36 -- Performing Test ADS_CXX_SUPPORTS_-Wduplicated-cond - Success
37 -- Performing Test ADS_CXX_SUPPORTS_-Wduplicated-branches
38 -- Performing Test ADS_CXX_SUPPORTS_-Wduplicated-branches - Success
39 -- Found Git: /usr/bin/git (found version "2.43.0")
40 -- Looking for sgemm_
41 -- Looking for sgemm_ - not found
42 -- Performing Test CMAKE_HAVE_LIBC_PTHREAD
43 -- Performing Test CMAKE_HAVE_LIBC_PTHREAD - Success
44 -- Found Threads: TRUE
45 -- Looking for sgemm_
46 -- Looking for sgemm_ - found
47 -- Found BLAS: /usr/lib/aarch64-linux-gnu/libblas.so
48 -- Looking for cheev_
49 -- Looking for cheev_ - not found
50 -- Looking for cheev_
51 -- Looking for cheev_ - found
52 -- Found LAPACK: /usr/lib/aarch64-linux-gnu/liblapack.so;/usr/lib/aarch64-linux-gnu/libblas.so
53 -- Found Boost: /usr/lib/aarch64-linux-gnu/cmake/Boost-1.83.0/BoostConfig.cmake (found ↩
↩suitable version "1.83.0", minimum required is "1.58.0")
54 -- Found Boost: /usr/lib/aarch64-linux-gnu/cmake/Boost-1.83.0/BoostConfig.cmake (found ↩
↩suitable version "1.83.0", minimum required is "1.58.0") found components: serialization ↩
↩iostreams
55 -- Configuring done (0.8s)
56 -- Generating done (0.0s)
57 CMake Warning:
58   Manually-specified variables were not used by the project:
59
60     USE_MUMPS
61
62
63 -- Build files have been written to: /code/build

```

4. Log z Kompilacji IGA-ADS

Komenda Kompilacji

```
1  ninja -C build
```

Wynik Kompilacji

```

1  -- Found Boost: /usr/lib/aarch64-linux-gnu/cmake/Boost-1.83.0/BoostConfig.cmake (found ↩
↩suitable version "1.83.0", minimum required is "1.58.0")
2  -- Found Boost: /usr/lib/aarch64-linux-gnu/cmake/Boost-1.83.0/BoostConfig.cmake (found ↩
↩suitable version "1.83.0", minimum required is "1.58.0") found components: serialization ↩
↩iostreams
3  -- Configuring done (0.0s)
4  -- Generating done (0.0s)
5  -- Build files have been written to: /code/build
6  ninja: Entering directory `build'

```

```

7 [1/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/simulation/simulation_base.cpp.o
8 [2/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/quad/gauss_data.cpp.o
9 [3/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/version.cpp.o
10 [4/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/bspline/bspline.cpp.o
11 [5/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/basis_data.cpp.o
12 [6/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/simulation/dimension.cpp.o
13 [7/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/form_matrix.cpp.o
14 [8/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/simulation/simulation_3d.cpp.o
15 [9/80] Building CXX object tests/CMakeFiles/ads-suite.dir/ads/bspline/eval_test.cpp.o
16 [10/80] Building CXX object tests/CMakeFiles/ads-suite.dir/ads/lin/band_solve_test.cpp.o
17 [11/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/simulation/simulation_1d.cpp.o
18 [12/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/simulation/simulation_2d.cpp.o
19 [13/80] Building CXX object tests/CMakeFiles/ads-suite.dir/ads/util/multi_array_test.cpp.o
20 [14/80] Building CXX object tests/CMakeFiles/ads-suite.dir/ads/basis_data_test.cpp.o
21 [15/80] Building CXX object tests/CMakeFiles/ads-suite.dir/ads/bspline/bspline_test.cpp.o
22 [16/80] Building CXX object tests/CMakeFiles/ads-suite.dir/ads/lin/dense_solve_test.cpp.o
23 [17/80] Building CXX object CMakeFiles/ads-objects.dir/src/ads/executor/galois.cpp.o
24 [18/80] Linking CXX static library libads.a
25 [19/80] Building CXX object tests/CMakeFiles/ads-suite.dir/ads/lin/tensor_test.cpp.o
26 [20/80] Building CXX object examples/CMakeFiles/ads-example-heat_3d.dir/heat/heat_3d.cpp.o
27 [21/80] Linking CXX executable examples/heat_3d
28 [22/80] Building CXX object tests/CMakeFiles/ads-suite.dir/ads/solver_test.cpp.o
29 [23/80] Building CXX object examples/CMakeFiles/ads-example-heat_1d.dir/heat/heat_1d.cpp.o
30 [24/80] Linking CXX executable examples/heat_1d
31 [25/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-scalability.dir/scalability/main.cpp.o
32 [26/80] Linking CXX executable tests/suite
33 [27/80] Linking CXX executable examples/scalability
34 [28/80] Building CXX object examples/CMakeFiles/ads-example-validation.dir/validation/main.cpp.o
35 [29/80] Linking CXX executable examples/validation
36 [30/80] Building CXX object examples/CMakeFiles/ads-example-multistep.dir/multistep/scheme.cpp.o
37 [31/80] Building CXX object examples/CMakeFiles/ads-example-heat_2d.dir/heat/heat_2d.cpp.o
38 [32/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-elasticity_victor.dir/elasticity/victor.cpp.o
39 [33/80] Linking CXX executable examples/heat_2d
40 [34/80] Linking CXX executable examples/elasticity_victor
41 [35/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-linear_elasticity.dir/elasticity/main.cpp.o
42 [36/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-maxwell-common.dir/maxwell/state.cpp.o
43 [37/80] Linking CXX executable examples/linear_elasticity
44 [38/80] Building CXX object examples/CMakeFiles/ads-example-flow.dir/flow/main.cpp.o
45 [39/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-maxwell-common.dir/maxwell/results.cpp.o
46 [40/80] Building CXX object examples/CMakeFiles/ads-example-pollution.dir/pollution/main.cpp.o
47 [41/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-maxwell-common.dir/maxwell/spaces.cpp.o
48 [42/80] Linking CXX executable examples/flow
49 [43/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-elasticity_pouria.dir/elasticity/elasticity_pouria.cpp.o
50 [44/80] Linking CXX executable examples/pollution
51 [45/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-maxwell_ads.dir/maxwell/maxwell_head_problem.cpp.o
52 [46/80] Linking CXX executable examples/elasticity_pouria
53 [47/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-maxwell_ads.dir/maxwell/head_data.cpp.o
54 [48/80] Building CXX object ↵
↵examples/CMakeFiles/ads-example-tumor.dir/tumor/vasculature/plot.cpp.o
55 [49/80] Building CXX object ↵

```

```

↪examples/CMakeFiles/ads-example-tumor.dir/tumor/vasculature/vasculature.cpp.o
56 [50/80] Building CXX object ↪
↪examples/CMakeFiles/ads-example-pollution_dpg_3d.dir/pollution/dpg3d.cpp.o
57 [51/80] Building CXX object examples/CMakeFiles/ads-example-victor.dir/victor/main.cpp.o
58 [52/80] Linking CXX executable examples/pollution_dpg_3d
59 [53/80] Linking CXX executable examples/victor
60 [54/80] Building CXX object ↪
↪examples/CMakeFiles/ads-example-tumor_3d.dir/tumor/3d/vasculature_parser.cpp.o
61 [55/80] Building CXX object examples/CMakeFiles/ads-example-erikkson.dir/erikkson/main.cpp.o
62 [56/80] Building CXX object ↪
↪examples/CMakeFiles/ads-example-maxwell-common.dir/maxwell/maxwell_base.cpp.o
63 [57/80] Building CXX object examples/CMakeFiles/ads-example-pollution_dpg.dir/pollution/dpg.cpp.o
64 [58/80] Linking CXX executable examples/erikkson
65 [59/80] Linking CXX executable examples/pollution_dpg
66 [60/80] Building CXX object examples/CMakeFiles/ads-example-tumor.dir/tumor/tumor_main.cpp.o
67 [61/80] Building CXX object examples/CMakeFiles/ads-example-demkowicz.dir/demkowicz/main.cpp.o
68 [62/80] Linking CXX executable examples/demkowicz
69 [63/80] Building CXX object examples/CMakeFiles/ads-example-multistep.dir/multistep/main.cpp.o
70 [64/80] Linking CXX executable examples/multistep
71 [65/80] Building CXX object examples/CMakeFiles/ads-example-tumor.dir/tumor/tumor.cpp.o
72 [66/80] Linking CXX executable examples/tumor
73 [67/80] Building CXX object tools/CMakeFiles/ads-error.dir/error.cpp.o
74 [68/80] Building CXX object examples/CMakeFiles/ads-example-implicit.dir/implicit/main.cpp.o
75 [69/80] Linking CXX executable tools/ads-error
76 [70/80] Linking CXX executable examples/implicit
77 [71/80] Building CXX object examples/CMakeFiles/ads-example-fire.dir/fire/fire.cpp.o
78 In file included from /code/examples/fire/fire.cpp:4:
79 /code/examples/fire/fire.hpp: In lambda function:
80 /code/examples/fire/fire.hpp:98:36: warning: unused parameter 'x' [-Wunused-parameter]
81     98 |         auto fuel_init = [](double x, double y) { return 1; };
82         |                             ~~~~~~^
83 /code/examples/fire/fire.hpp:98:46: warning: unused parameter 'y' [-Wunused-parameter]
84     98 |         auto fuel_init = [](double x, double y) { return 1; };
85         |                             ~~~~~~^
86 /code/examples/fire/fire.hpp: In lambda function:
87 /code/examples/fire/fire.hpp:129:22: warning: variable 'x' set but not used ↪
↪[-Wunused-but-set-variable]
88     129 |             auto x = point(e, q);
89         |             ^
90 /code/examples/fire/fire.hpp: In member function 'void ads::problems::fire::compute_rhs(double)':
91 /code/examples/fire/fire.hpp:116:29: warning: unused parameter 't' [-Wunused-parameter]
92     116 |     void compute_rhs(double t) {
93         |         ~~~~~~^
94 [72/80] Building CXX object examples/CMakeFiles/ads-example-coupled.dir/implicit/coupled.cpp.o
95 [73/80] Linking CXX executable examples/fire
96 [74/80] Linking CXX executable examples/coupled
97 [75/80] Building CXX object examples/CMakeFiles/ads-example-tumor_3d.dir/tumor/3d/main.cpp.o
98 [76/80] Linking CXX executable examples/tumor_3d
99 [77/80] Building CXX object ↪
↪examples/CMakeFiles/ads-example-maxwell_uniform.dir/maxwell/main_uniform.cpp.o
100 [78/80] Building CXX object ↪
↪examples/CMakeFiles/ads-example-maxwell_ads.dir/maxwell/main_ads.cpp.o
101 [79/80] Linking CXX executable examples/maxwell_uniform
102 [80/80] Linking CXX executable examples/maxwell_ads

```

5. Wyniki Uruchomienia Symulacji

Komenda Uruchomienia

```
1 ./examples/heat_2d
```

Listing Katalogu z Wynikami

```
1 WARNING: Numa support configured but not present at runtime. Assuming numa topology matches ↵
↵socket topology.
2 integration: 12689
3 total 220064
4 drwxr-xr-x 10 root root 4096 Oct 18 17:17 .
5 drwxr-xr-x 1 root root 4096 Oct 18 17:17 ..
6 -rw-r--r-- 1 root root 256032 Oct 18 17:17 .ninja_deps
7 -rw-r--r-- 1 root root 7960 Oct 18 17:17 .ninja_log
8 -rw-r--r-- 1 root root 28776 Oct 18 17:17 CMakeCache.txt
9 drwxr-xr-x 7 root root 4096 Oct 18 17:17 CMakeFiles
10 -rw-r--r-- 1 root root 3305 Oct 18 17:17 CPackConfig.cmake
11 -rw-r--r-- 1 root root 3651 Oct 18 17:17 CPackSourceConfig.cmake
12 -rw-r--r-- 1 root root 318 Oct 18 17:17 CTestTestfile.cmake
13 -rw-r--r-- 1 root root 2437 Oct 18 17:17 DartConfiguration.tcl
14 drwxr-xr-x 3 root root 4096 Oct 18 17:17 Testing
15 -rw-r--r-- 1 root root 2762 Oct 18 17:17 ads-config-version.cmake
16 -rw-r--r-- 1 root root 421 Oct 18 17:17 ads-config.cmake
17 -rw-r--r-- 1 root root 132512 Oct 18 17:17 build.ninja
18 -rw-r--r-- 1 root root 4545 Oct 18 17:17 cmake_install.cmake
19 drwxr-xr-x 3 root root 4096 Oct 18 17:17 examples
20 drwxr-xr-x 3 root root 4096 Oct 18 17:17 external
21 drwxr-xr-x 3 root root 4096 Oct 18 17:17 include
22 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 init.data
23 -rw-r--r-- 1 root root 198572 Oct 18 17:17 libads.a
24 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_0.data
25 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_100.data
26 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1000.data
27 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1100.data
28 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1200.data
29 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1300.data
30 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1400.data
31 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1500.data
32 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1600.data
33 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1700.data
34 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1800.data
35 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_1900.data
36 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_200.data
37 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2000.data
38 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2100.data
39 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2200.data
40 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2300.data
41 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2400.data
42 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2500.data
43 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2600.data
44 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2700.data
45 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2800.data
46 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_2900.data
47 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_300.data
48 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_3000.data
49 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_3100.data
50 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_3200.data
51 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_3300.data
52 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_3400.data
53 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_3500.data
```



```
113 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_900.data
114 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9000.data
115 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9100.data
116 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9200.data
117 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9300.data
118 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9400.data
119 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9500.data
120 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9600.data
121 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9700.data
122 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9800.data
123 -rw-r--r-- 1 root root 2222055 Oct 18 17:17 out_9900.data
124 drwxr-xr-x 4 root root 4096 Oct 18 17:17 src
125 drwxr-xr-x 3 root root 4096 Oct 18 17:17 tests
126 drwxr-xr-x 3 root root 4096 Oct 18 17:17 tools
```

6. Jaki największy krok czasowy nie powoduje eksplozji symulacji?

Odpowiedź: $2.9e-5$

Dowód: Animacja pokazuje stabilną symulację bez błędów numerycznych.

Analiza przeprowadzona ręcznie poprzez sprawdzenie kolejnych wartości.

Animacja Stabilnej Symulacji

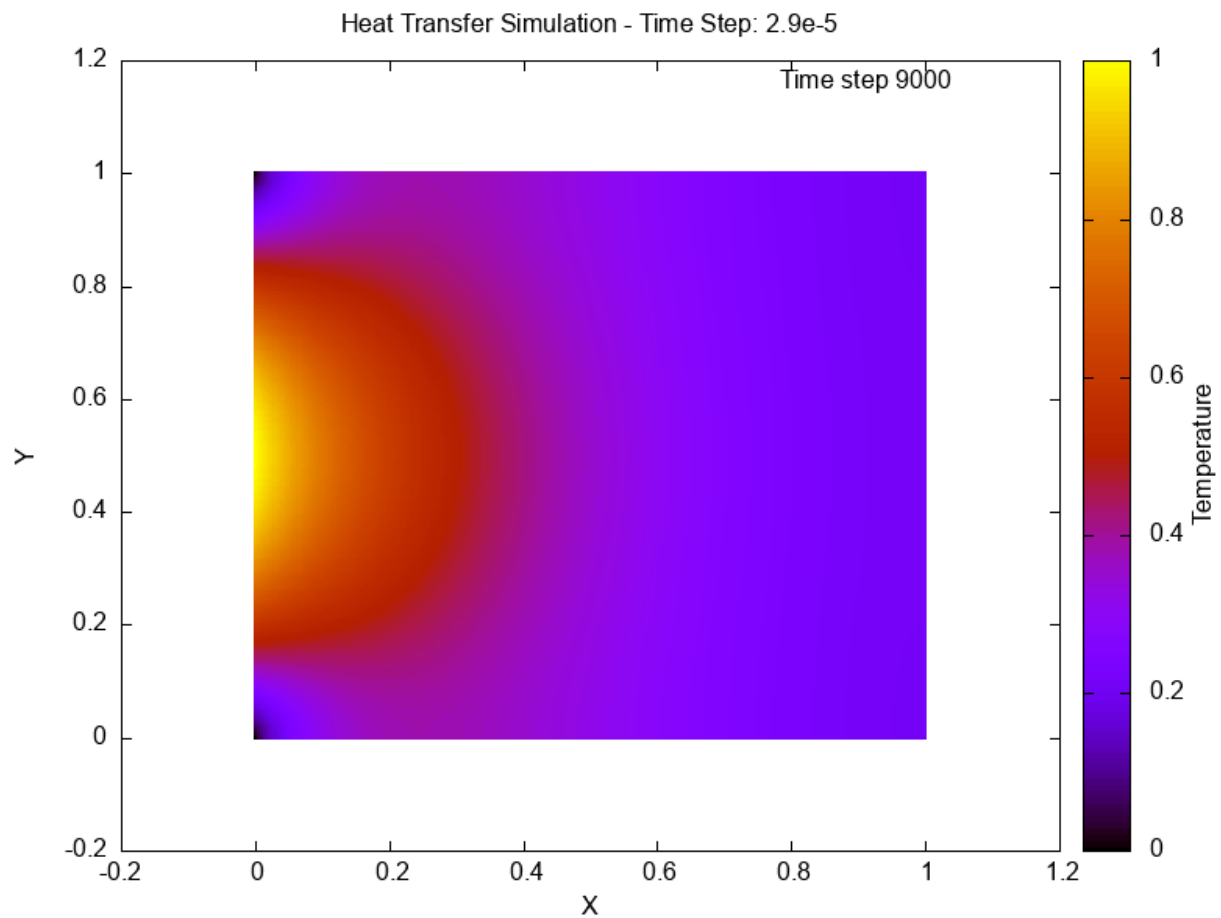


Figure 1: heat_2d_2.9e-5.png

7. Jaki najmniejszy krok czasowy powoduje eksplozję symulacji?

Odpowiedź: 2.91e-5

Dowód: Animacja pokazuje niestabilną symulację z błędami numerycznymi i eksplozją.

Animacja Niestabilnej Symulacji

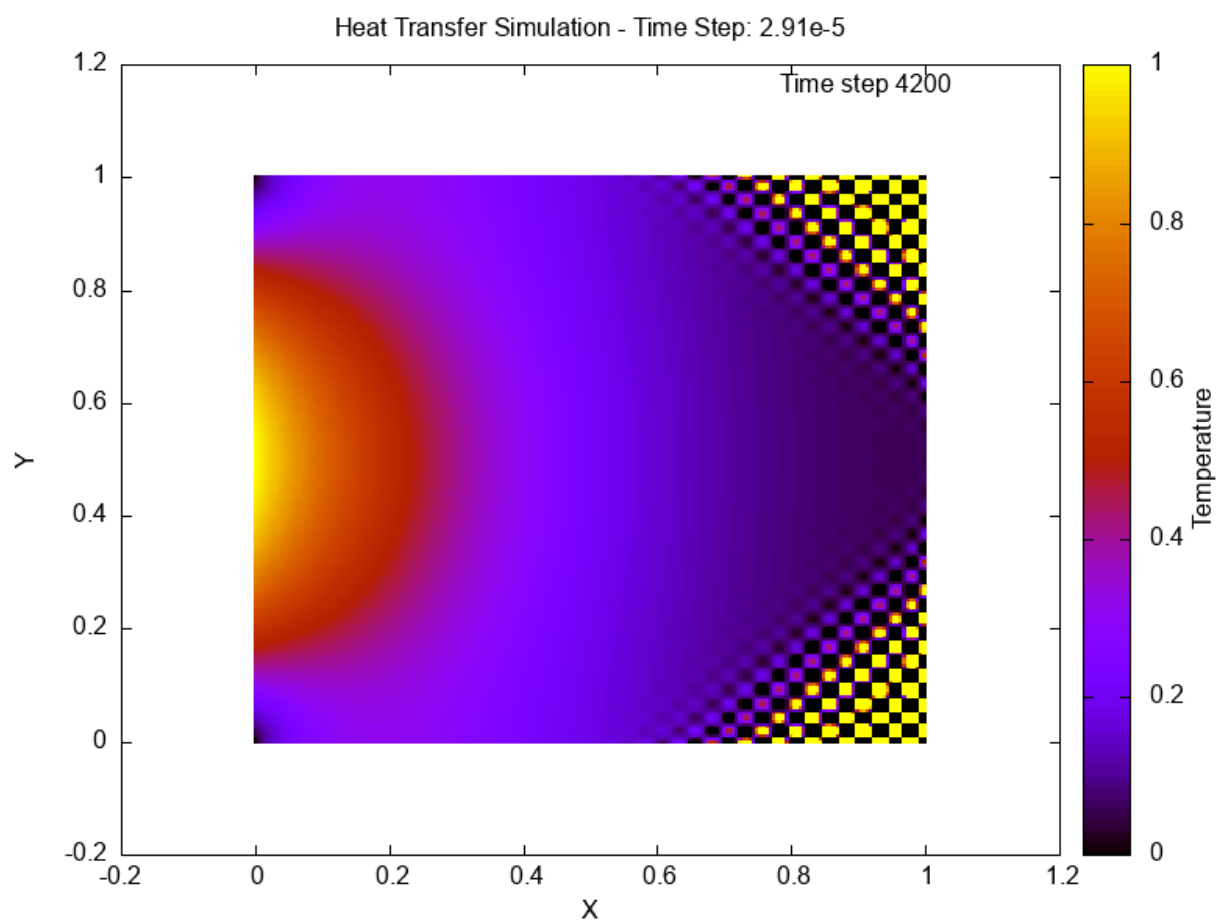


Figure 2: heat_2d_2.91e-5.png