

C++ code 11.10.6: Sub-problem (11-10.a): Monitoring convergence of symplectic timestep-ping method for oscillator equation

```
2 void sympTimesteppingODETest() {
3     constexpr unsigned int nlter = 7;    // total number of iterations
4     unsigned int m;                      // number of equidistant steps
5     std::vector<double> errors(nlter);    // errors vector for all approx. sols
6     Eigen::Vector2d approx_sol;
7     approx_sol << 0.0, 1.0;             // initial conditions
8     for (int k = 0; k < nlter; k++) {
9         m = 10 * std::pow(2, k);
10        // TODO: (11-10.b) Evaluate the error at the final step between the approx
11        // solutions as given by the symplectic method and the exact solution
12        // computed from the analytic formula.
13        // START
14        const double tau = 2.0 * M_PI / m;
15        for (unsigned int i = 0; i < m; i++) {
16            sympTimestep(tau, approx_sol);
17        }
18        // Computing the error in the maximum norm
19        errors[k] = std::abs(std::sin(2.0 * M_PI) - approx_sol[0]) +
20                    std::abs(std::cos(2.0 * M_PI) - approx_sol[1]);
21        // END
22    }
23    // Printing results
24    std::cout << "Convergence of Symplectic Time Stepping Method:\n";
25    std::cout << "\tM\t\tterr(M)\n";
26    for (unsigned int k = 0; k < nlter; k++) {
27        std::cout << "\t" << 10 * std::pow(2, k) << "\t\t" << errors[k]
28                << std::endl;
29    }
30 }
```

Get it on  GitLab (symplectic.hpp).