

# NumericalPropagationWithManeuverSequence 4.4

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```
public class NumericalPropagationWithManeuverSequence {

    public static void main(String[] args) throws PatriusException,
    IOException, URISyntaxException {

        // Patrius Dataset initialization (needed for example to get the UTC
time)
        PatriusDataset.addResourcesFromPatriusDataset() ;

        // Recovery of the UTC time scale using a "factory" (not to duplicate
such unique object)
        final TimeScale TUC = TimeScalesFactory.getUTC();

        // Date of the orbit given in UTC time scale)
        final AbsoluteDate date = new AbsoluteDate("2010-01-01T12:00:00.000",
TUC);

        // Getting the frame with wich will defined the orbit parameters
// As for time scale, we will use also a "factory".
        final Frame GCRF = FramesFactory.getGCRF();

        // Initial orbit
        final double sma = 7200.e+3;
        final double exc = 0.01;
        final double per = sma*(1.-exc);
        final double apo = sma*(1.+exc);
        final double inc = FastMath.toRadians(98.);
        final double pa = FastMath.toRadians(0.);
        final double raan = FastMath.toRadians(0.);
        final double anm = FastMath.toRadians(0.);
        final double MU = Constants.WGS84_EARTH_MU;

        final ApsisRadiusParameters par = new ApsisRadiusParameters(per, apo,
inc, pa, raan, anm, PositionAngle.MEAN, MU);
        final Orbit iniOrbit = new ApsisOrbit(par, GCRF, date);

//SPECIFIC
        // Creating a mass model (see also specific example)
        final AssemblyBuilder builder = new AssemblyBuilder();

        // Main part
        final double iniMass = 900.;
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builder.addMainPart("MAIN");
builder.addProperty(new MassProperty(iniMass), "MAIN");

// Tank part (ergols mass)
final double ergolsMass = 100.;
final TankProperty tank = new TankProperty(ergolsMass);
builder.addPart("TANK", "MAIN", Transform.IDENTITY);
builder.addProperty(tank, "TANK");

// Engine part
final double isp = 300.;
final double thrust = 400.;
final PropulsiveProperty prop = new PropulsiveProperty(thrust, isp);
// au lieu de new PropulsiveProperty("PROP", thrust, isp);

builder.addPart("PROP", "MAIN", Transform.IDENTITY);
builder.addProperty(prop, "PROP");

final Assembly assembly = builder.returnAssembly();
final MassProvider mm = new MassModel(assembly);

// We create a spacecraftstate
final SpacecraftState iniState = new SpacecraftState(iniOrbit, mm);
//SPECIFIC

// Initialization of the Runge Kutta integrator with a 2 s step
final double pasRk = 2.;
final FirstOrderIntegrator integrator = new
ClassicalRungeKuttaIntegrator(pasRk);

// Initialization of the propagator
final NumericalPropagator propagator = new
NumericalPropagator(integrator);
propagator.resetInitialState(iniState);

// Forcing integration using cartesian equations
propagator.setOrbitType(OrbitType.CARTESIAN);

//SPECIFIC
// Event corresponding to the criteria to trigger the impulsive
maneuver
final EventDetector event = new DateDetector(date);
// Creation of the impulsive maneuver
final Vector3D deltaV = new Vector3D(20., 0., 0.);
final ImpulseManeuver imp = new ImpulseManeuver(event, deltaV, prop,
mm, tank, LOFType.TNW);

// Duration of the maneuver to reach the initial semi major axis
final double duration = 51.03781404091;
// Creation of the continuous thrust maneuver
final AbsoluteDate startDate =

```

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date.shiftedBy(0.5*(iniOrbit.getKeplerianPeriod()-duration));
    final EventDetector eventStart = new DateDetector(startDate);
    final EventDetector eventEnd = new
DateDetector(startDate.shiftedBy(duration));
    final Vector3D direction = new Vector3D(-1., 0., 0.);
    final ContinuousThrustManeuver man = new
ContinuousThrustManeuver(eventStart, eventEnd, prop, direction, mm, tank);

    // Creation of the sequence of maneuver
    ManeuversSequence seq = new ManeuversSequence(0., 0.);
    seq.add(imp);
    seq.add(man);

    // Adding the maneuver sequence to the propagator
    seq.applyTo(propagator);
    // Adding additional state (change name add to set for V3.3)
    propagator.setMassProviderEquation(mm);

    // Adding an attitude law (or attitude sequence : mandatory)
    final AttitudeLaw attitudeLaw = new LofOffset(LOFType.TNW,
RotationOrder.ZYX, 0., 0., 0.);
    propagator.setAttitudeProvider(attitudeLaw);
//SPECIFIC

    // Propagating 100s
    final double dt = iniOrbit.getKeplerianPeriod();
    final AbsoluteDate finalDate = date.shiftedBy(dt);
    final SpacecraftState finalState = propagator.propagate(finalDate);
    final Orbit finalOrbit = finalState.getOrbit();

    // Printing new date and semi major axis
    System.out.println();
    System.out.println("Initial semi major axis =
"+iniOrbit.getA()/1000.+ " km");
    System.out.println("New date = "+finalOrbit.getDate().toString(TUC)+"
deg");
    System.out.println("Final semi major axis =
"+finalOrbit.getA()/1000.+ " km");
    // Printing mass
    System.out.println();
    System.out.println("Dry Mass = "+finalState.getMass("MAIN")+ " kg");
    System.out.println("Ergols Mass = "+finalState.getMass("TANK")+
kg");

    System.out.println(((DateDetector)event).getDate().toString(TUC));

System.out.println(((DateDetector)eventStart).getDate().toString(TUC));
    System.out.println(((DateDetector)eventEnd).getDate().toString(TUC));

}

```

}

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