
```

function dPhiX = STMEOM_J2(t,XPhi,mu,Ri)
% Function for the equations of motion for an STM of the 2 body problem
% including J2 contributions
% Inputs:
%   - t: Current integration time
%   - XPhi: State transition matrix and state vector (7^2 + 7)x1:
%           [X; Phi]
%   - mu: Gravitational parameter for the central body of interest
%   - Ri: Reference radius
%
% Outputs:
%   - dPhiX: Rate of change vector for the provided STM and state.
%           Note: dPhi is 7^2x1, not 7x7!
%           [dPhi; dX]
%
% By: Ian Faber, 01/23/2025
%

x = XPhi(1);
y = XPhi(2);
z = XPhi(3);
xDot = XPhi(4);
yDot = XPhi(5);
zDot = XPhi(6);
J2 = XPhi(7);
Phi = XPhi(8:56);

Phi = reshape(Phi, 7, 7); % Phi is converted into a 49x1 vector...

X_a = [x; y; z; xDot; yDot; zDot; mu; J2];

r = sqrt(x^2 + y^2 + z^2);

A = DynamicsPartials_MuJ2(X_a, Ri);

dPhi_mat = A*Phi;
dPhi = reshape(dPhi_mat,49,1); % Need to convert back to a column vector...

X0 = [x;y;z;xDot;yDot;zDot;J2];
dX = orbitEOM_MuJ2(t,X0,mu,Ri);

dPhiX = [dX; dPhi];

end

XDot =

    1.0e+12 *

    0.0000000000000876
   -0.0000000000000243
    0.0000000000000167

```

```
-3.413686753568604
 3.207050117068763
-0.357531958249240
      0
```

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PhiDot_mat =
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```
1.0e+13 *
```

```
Columns 1 through 3
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```
-0.0000000000000028    0.0000000000000140    0.0000000000000079
 0.0000000000000060   -0.0000000000000137    0.0000000000000093
 0.00000000000000178   -0.0000000000000029   -0.0000000000000049
 0.374936725526471    0.220415198396986    0.712850905227827
-0.359462275935478   -1.330425361600812   -0.464009296480646
 1.912845832957822    0.261325351717644    0.070365033084850
      0                      0                      0
```

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Columns 4 through 6
```

```
-0.0000000000000054    0.0000000000000093    0.0000000000000020
-0.0000000000000016   -0.0000000000000148    0.0000000000000043
 0.0000000000000061   -0.0000000000000056   -0.0000000000000127
-0.973504410324571   -0.308043951672802    1.337366787539103
 0.882180120948528   -0.310126639387312   -1.708438336510815
-0.326422999680118   -0.614276201454800   -0.012194092462935
      0                      0                      0
```

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Column 7
```

```
0.0000000000000004
 0.0000000000000028
 0.0000000000000006
 0.622263144368798
-0.471646032233606
-1.110000530701040
      0
```

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