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function [x_mc, P_mc] = monte_carlo_propagation(r0, v0, P0, tprop, N)
%-----
% MONTE_CARLO_PROPAGATION Propagate orbit uncertainty using Monte Carlo
%-----
%
% Inputs:
%   x0      : 6x1 initial state [r0; v0]  [m, m/s]
%   P0      : 6x6 initial covariance  [m^2, (m/s)^2]
%   tprop   : propagation time [s]
%   mu      : gravitational parameter [m^3/s^2]
%   N       : number of Monte Carlo particles
%
% Outputs:
%   x_mc    : propagated mean state
%   P_mc    : propagated covariance

% Generate Monte Carlo particles
P0 = (P0 + P0')/2; % force symmetry
[eigvec, eigval] = eig(P0);
eigval(eigval < 0) = 0; % set negative eigenvalues to zero
P_psd = eigvec * eigval * eigvec';
X0 = mvnrnd([r0;v0], P_psd, N)'; % 6 x N

% Preallocate
Xprop = zeros(size(X0));

% Propagate each particle
for i = 1:N
    [r_mc(:,i) v_mc(:,i), ~, ~, ~] = Propagate(tprop, X0(1:3, i), X0(4:6, i), ↵
0);
end

% Compute mean and covariance
x_mc = mean([r_mc; v_mc], 2);
P_mc = cov([r_mc; v_mc]');
end

```