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% C. Petersen, H. Werkle, Dynamik der Baukonstruktionen
% 2. Auflage, Springer Vieweg, Wiesbaden, 2018
%
% ML_04_1_Massenmomente_2_Ordnung: Massenmomente 2. Ordnung
%
% Version 1.0, April 2018
% Softwareentwicklung:
% Andrei Firus, M.Eng (andrei.firus@gmail.com)

% Aufbau Eingabedateien:
% Inputdatei_1: Anzahl der Eckpunkte der Teilflächen
% Inputdatei_2: Koordinaten der Eckpunkte für alle Teilflächen in
%               aufsteigender Reihenfolge (tripelweise Eingabe je Zeile,
%               'x', 'y', 'z').

% ANMERKUNG: Dezimaltrennzeichen '.'

% Ausgabedateien:
% Outputdatei_1: Eingaben- und Ergebnisübersicht

%----- EINGABEBLOCK -----
% Einlesen von Eingabedateien und Generierung der entsprechenden Vektoren
% und Matrizen

% Anzahl der Eckpunkten je Teilfläche
n=dlmread('Inputdatei_1.txt');

% Koordinaten der Eckpunkten für jede Teilfläche
Koordinaten=dlmread('Inputdatei_2.txt');
%-----

%----- BERECHNUNGSBLOCK -----
% Anzahl der Teilflächen
m=length(n);

% Gesamtanzahl der Knoten bisheriger Teilflächen
summe=zeros(m,1);
summe(1)=0;
for k=2:1:m
    summe(k)=summe(k-1)+n(k-1);
end

% Koordinaten der Knoten jeder Teilfläche
x=zeros(m,max(n));
y=zeros(m,max(n));
z=zeros(m,max(n));
for i=1:1:m
    for j=1:1:n(i)
        x(i,j)=Koordinaten(summe(i)+j,1);
        y(i,j)=Koordinaten(summe(i)+j,2);
        z(i,j)=Koordinaten(summe(i)+j,3);
    end
end

% Definition der Berechnungsvektoren
ax=zeros(m,1); ay=zeros(m,1); az=zeros(m,1);

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V_m=zeros(m,1);

Sx_m=zeros(m,1); Sy_m=zeros(m,1); Sz_m=zeros(m,1);
jxx=zeros(m,1); jyy=zeros(m,1); jzz=zeros(m,1);
jxy=zeros(m,1); jyz=zeros(m,1); jzx=zeros(m,1);

for i=1:1:m
    u=1;
    for j=1:1:n(i)-2

        v=j+1; w=j+2;

        x1=x(i,u); x2=x(i,v); x3=x(i,w);
        y1=y(i,u); y2=y(i,v); y3=y(i,w);
        z1=z(i,u); z2=z(i,v); z3=z(i,w);

        A1=(y1*z2-y2*z1+y2*z3-y3*z2+y3*z1-y1*z3)/2;
        A2=(-x1*z2+x2*z1-x2*z3+x3*z2-x3*z1+x1*z3)/2;
        A3=(x1*y2-x2*y1+x2*y3-x3*y2+x3*y1-x1*y3)/2;

        v_m=(x1*y2*z3+y1*z2*x3+x2*y3*z1-z1*y2*x3-y1*x2*z3-z2*y3*x1)/6;

        s1=(x1+x2+x3)*...
            (x1*y2*z3+y1*z2*x3+x2*y3*z1-z1*y2*x3-y1*x2*z3-z2*y3*x1)/24;
        s2=(y1+y2+y3)*...
            (x1*y2*z3+y1*z2*x3+x2*y3*z1-z1*y2*x3-y1*x2*z3-z2*y3*x1)/24;
        s3=(z1+z2+z3)*...
            (x1*y2*z3+y1*z2*x3+x2*y3*z1-z1*y2*x3-y1*x2*z3-z2*y3*x1)/24;

        a_i_1=(y1*z2-y2*z1+y2*z3-y3*z2+y3*z1-y1*z3);
        a_i_2=(-x1*z2+x2*z1-x2*z3+x3*z2-x3*z1+x1*z3);
        a_i_3=(x1*y2-x2*y1+x2*y3-x3*y2+x3*y1-x1*y3);

        DJ1=((x1^2+x2^2+x3^2)*(x1+x2+x3)+x1*x2*x3)*a_i_1/60;
        DJ2=((y1^2+y2^2+y3^2)*(y1+y2+y3)+y1*y2*y3)*a_i_2/60;
        DJ3=((z1^2+z2^2+z3^2)*(z1+z2+z3)+z1*z2*z3)*a_i_3/60;

        b_1_2=x1*(3*y1^2+2*y1*y2+2*y1*y3+y2^2+y2*y3+y3^2);
        c_1_2=x2*(y1^2+2*y1*y2+y1*y3+3*y2^2+2*y2*y3+y3^2);
        d_1_2=x3*(y1^2+y1*y2+2*y1*y3+y2^2+2*y2*y3+3*y3^2);

        b_2_3=y1*(3*z1^2+2*z1*z2+2*z1*z3+z2^2+z2*z3+z3^2);
        c_2_3=y2*(z1^2+2*z1*z2+z1*z3+3*z2^2+2*z2*z3+z3^2);
        d_2_3=y3*(z1^2+z1*z2+2*z1*z3+z2^2+2*z2*z3+3*z3^2);

        b_3_1=z1*(3*x1^2+2*x1*x2+2*x1*x3+x2^2+x2*x3+x3^2);
        c_3_1=z2*(x1^2+2*x1*x2+x1*x3+3*x2^2+2*x2*x3+x3^2);
        d_3_1=z3*(x1^2+x1*x2+2*x1*x3+x2^2+2*x2*x3+3*x3^2);

        j_mxy=(b_1_2+c_1_2+d_1_2)*a_i_2/120;
        j_myz=(b_2_3+c_2_3+d_2_3)*a_i_3/120;
        j_mzx=(b_3_1+c_3_1+d_3_1)*a_i_1/120;

        % Flächenvektoren der Teilfläche m
        ax(i)=ax(i)+A1; ay(i)=ay(i)+A2; az(i)=az(i)+A3;
    end
end

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    % Volumenanteil der Teilfläche m
    V_m(i)=V_m(i)+v_m;

    % Statische Momente: Anteil der Teilfläche m
    Sx_m(i)=Sx_m(i)+s1; Sy_m(i)=Sy_m(i)+s2; Sz_m(i)=Sz_m(i)+s3;

    % Auf Dichte bezogene Massenträgheitsmomente (Anteil der
    % Teilfläche m)
    jxx(i)=jxx(i)+DJ2+DJ3; jyy(i)=jyy(i)+DJ3+DJ1;
    jzz(i)=jzz(i)+DJ1+DJ2;
    jxy(i)=jxy(i)+j_mxy; jyz(i)=jyz(i)+j_myz; jzx(i)=jzx(i)+j_mzx;
end
end

% Summe aller Flächenvektoren (zur Kontrolle, sie muss verschwinden)
Ax=sum(ax); Ay=sum(ay); Az=sum(az);

% Gesamtvolumen (Summation über alle Teilflächen)
V=sum(V_m);

% Statische Momente (Summation über alle Teilflächen)
Sx=sum(Sx_m); Sy=sum(Sy_m); Sz=sum(Sz_m);

% auf die Dichte bezogene Massenmomente 2. Ordnung
% (Summation über alle Teilflächen)
Jxx=sum(jxx); Jyy=sum(jyy); Jzz=sum(jzz);
Jxy=sum(jxy); Jyz=sum(jyz); Jzx=sum(jzx);

% Trägheitstensor (bezogen auf die Dichte)
J=[Jxx Jxy Jzx; Jxy Jyy Jyz; Jzx Jyz Jzz];

% Schwerpunktkoordinaten
xs=Sx/V; ys=Sy/V; zs=Sz/V;
%-----

%----- AUSGABEBLOCK -----
% Ausgabe der Ergebnisse in eine Datei
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fid = fopen('Outputdatei_1_Allgemein.txt', 'w');
fprintf(fid,...
    '%s\n','C. Petersen, H. Werkle, Dynamik der Baukonstruktionen');
fprintf(fid,...
    '%s\n','2. Auflage, Springer Vieweg, Wiesbaden, 2018');
fprintf(fid,...
    '%s\n','Softwareentwicklung: Andrei Firus (andrei.firus@gmail.com)');
fprintf(fid,'%s\n','Programm ML_04_1: Eingaben- und Ergebnisuebersicht');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,...
    '%s\n','-----');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid,...
    '%s\n','EINGABEDATEN:');
fprintf(fid, '%s\n', ' ');

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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Anzahl der Teilflaechen:');
fprintf(fid, '%.0f\n', m);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Anzahl der Eckpunkte je Teilflaechen');
fprintf(fid, '%s \t %s\n', 'Teilflaechen', 'Anzahl Eckpunkte');
for ii=1:1:m
    fprintf(fid, '%.0f \t %.0f\n', ii, n(ii));
end
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Koordinaten der Eckpunkten:');
fprintf(fid, '%s \t %s \t %s \t %s\n', 'Teilflaechen', 'x', 'y', 'z');
for ii=1:1:m
    for jj=1:1:n(ii)
        fprintf(fid, '%.0f \t \t %.2f \t %.2f \t %.2f\n', ...
            ii, Koordinaten(ii,:));
    end
end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, ...
    '%s\n', '-----');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, ...
    '%s\n', 'ERGEBNISSE:');
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Kontrolle (Summe der Flaechenvektoren):');
fprintf(fid, '%s \t %d\n', 'Summe Ax=', Ax);
fprintf(fid, '%s \t %d\n', 'Summe Ay=', Ay);
fprintf(fid, '%s \t %d\n', 'Summe Az=', Az);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Statische Momente:');
fprintf(fid, '%s \t %d\n', 'Sx=', Sx);
fprintf(fid, '%s \t %d\n', 'Sy=', Sy);
fprintf(fid, '%s \t %d\n', 'Sz=', Sz);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Schwerpunktkoordinaten:');
fprintf(fid, '%s \t %d\n', 'xs=', xs);
fprintf(fid, '%s \t %d\n', 'ys=', ys);
fprintf(fid, '%s \t %d\n', 'zs=', zs);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Volumen:');
fprintf(fid, '%s \t %d\n', 'V=', V);
fprintf(fid, '%s\n', ' ');
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
fprintf(fid, '%s\n', 'Massenmomente (bezogen auf die Dichte):');
fprintf(fid, '%s \t %d \t %s \t %d \t %s \t %d\n', ...
    'Jxx=', Jxx, 'Jxy=', Jxy, 'Jxz=', Jxz);
fprintf(fid, '%s \t %d \t %s \t %d \t %s \t %d\n', ...
    'Jyx=', Jyx, 'Jyy=', Jyy, 'Jyz=', Jyz);
fprintf(fid, '%s \t %d \t %s \t %d \t %s \t %d\n', ...
    'Jzx=', Jzx, 'Jzy=', Jzy, 'Jzz=', Jzz);

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[illegible]