DEMO_0006_Spherical_Cylindrical_Boundary

Table of Contents

This is a demo for:

- Building geometry for TPMS structures in spherical and cylindrical coordinates.

1. Example-1: TPMS in cylindrical coordinates in full cilinder and 5/4pi.

2. Example-2: TPMS in spherical coordinates.

Name

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```
Change log:
2023/11/15 MV Created
2024/02/1 MV Added Examples 1 & 2
----------------------------------------------------------------------
```

```
clear; close all; clc;
```

Plot settings

```
fontSize=20;
faceAlpha1=0.8;
markerSize=10;
lineWidth1=3;
lineWidth2=4;
markerSize1=25;
```

Control parameters

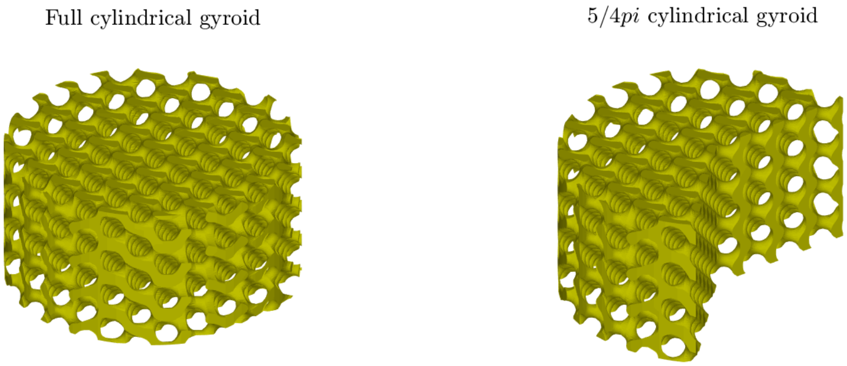
```
res=100; %Resolution

L=3; %Length size
Rg=3; %cylindrical radius

R=1; %Outter radius
r=0.5; %Inner radius
```

Example-1: Cylindrical TMPS (Figure-6(c,d))

Set parameters for individual gyroid

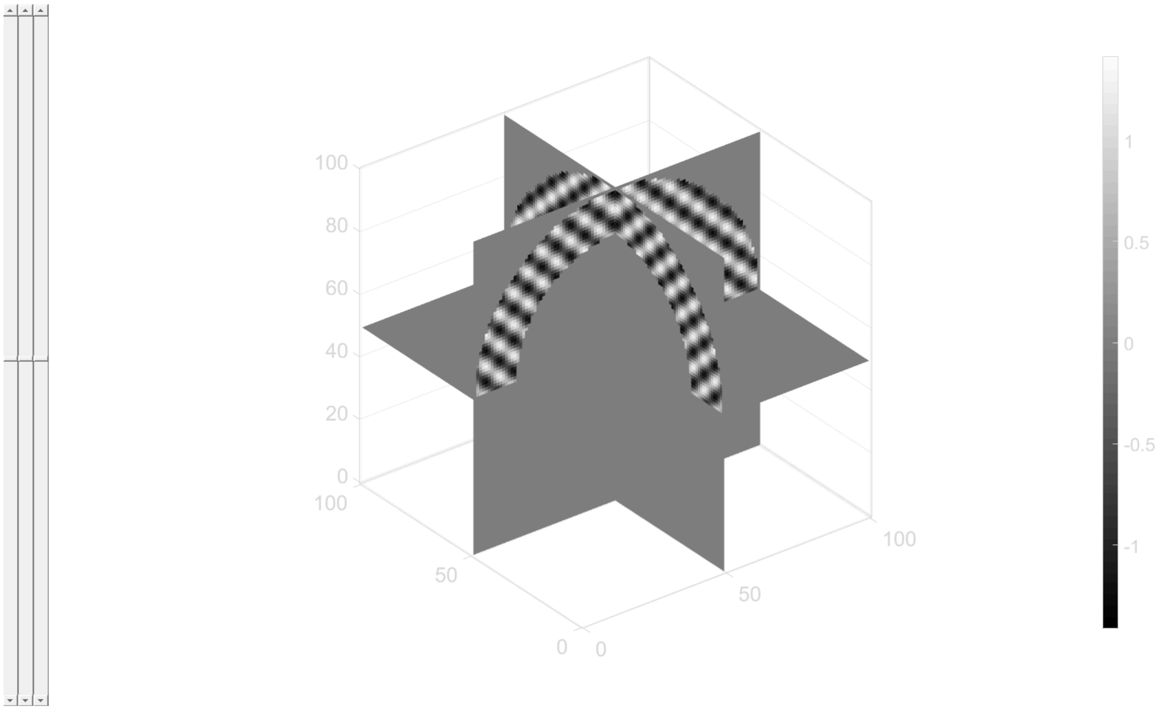
```
inputStruct_A.L=L; % characteristic length
inputStruct_A.R=Rg;
inputStruct_A.Ns=res; % number of sampling points
inputStruct_A.isocap=1; %Option to cap the isosurface
inputStruct_A.surfaceCase='g'; %Surface type
inputStruct_A.surfaceSide=-1;
inputStruct_A.numPeriods=[8 8 8]; %Number of periods in each direction
inputStruct_A.levelset=-0.7; %Isosurface level
inputStruct_A.gradiantF=0; %Gradiant Factor
levelset_A=inputStruct_A.levelset;

levelset=inputStruct_A.levelset;

% Structure_B: 5/4pi cross section
inputStruct_B=inputStruct_A;
inputStruct_B.thetaMax=5/4*pi;

% Compute cylindrical gyroid
% No need to store faces and vertices, only require underlying S,
% grid coordinates, and levelset values
[Fa,Va,Ca,S_A,~,~,~,~,~]=CylindricalTPMS(inputStruct_A);
[Fb,Vb,Cb,S_B,~,~,~,~,~]=CylindricalTPMS(inputStruct_B);

% Structure_A: Using grouping to keep only largest group
groupOptStruct.outputType='label';
[G,~,groupSize]=tesgroup(Fa,groupOptStruct); %Group connected faces
[~,indKeep]=max(groupSize); %Index of largest group
% Keep only largest group
Fa=Fa(G==indKeep,:); %Trim faces
Ca=Ca(G==indKeep,:); %Trim color data
[Fa,Va]=patchCleanUnused(Fa,Va); %Remove unused node

% Structure_B: Using grouping to keep only largest group
groupOptStruct.outputType='label';
[G,~,groupSize]=tesgroup(Fb,groupOptStruct); %Group connected faces
[~,indKeep]=max(groupSize); %Index of largest group
% Keep only largest group
Fb=Fb(G==indKeep,:); %Trim faces
Cb=Cb(G==indKeep,:); %Trim color data
[Fb,Vb]=patchCleanUnused(Fb,Vb); %Remove unused node

% Visualizing geometry
cFigure; hold on;
subplot(1,2,1);
title('Full cylindrical gyroid','FontSize', fontSize, Interpreter='latex')
gpatch(Fa,Va,[0.75, 0.75, 0],'none', 1);
axisGeom(gca,fontSize); axis off;
camlight headlight;
drawnow;
```

```
subplot(1,2,2);
title('$5/4pi$ cylindrical gyroid','FontSize', fontSize, Interpreter='latex')
gpatch(Fb,Vb,[0.75, 0.75, 0],'none', 1);
axisGeom(gca,fontSize); axis off;
camlight headlight;
drawnow;
```

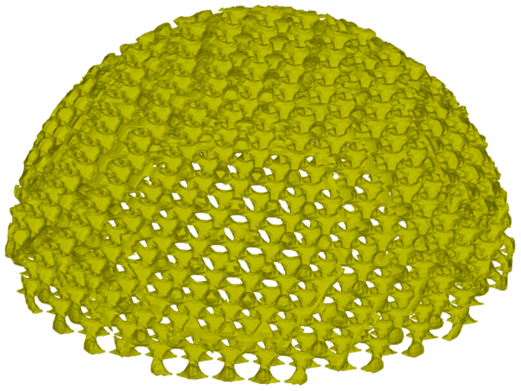


Example-2: Spherical TMPS (Figure-6(c,d))

```
surfType='d'; %'g' for Figure-6(a), 'd' for Figure-6(b)

inputStruct.L=[2 2 2]; % characteristic length
inputStruct.Ns=res; % number of sampling points
inputStruct.isocap=1; %Option to cap the isosurface
inputStruct.surfaceCase=surfType; %Surface type

% Set parameters & Compute individual gyroids
switch surfType
    case 'g'
        inputStruct.numPeriods=[10 10 10]; %Number of periods in each
 direction
        inputStruct.levelset=0.75; %Isosurface level
        inputStruct.gradiantF=0; %Gradiant Factor
        levelset=inputStruct.levelset;
        [~,~,~,S,X,Y,Z]=SphericalTPMS (inputStruct);

    case 'd'
        inputStruct.numPeriods=[10 10 10];
        inputStruct.levelset=0.6;
        inputStruct.gradiantF=0 ; %Gradiant Factor
        levelset=inputStruct.levelset;
        inputStruct.surfaceCase='d';
        [~,~,~,S,X,Y,Z]=SphericalTPMS (inputStruct);
end

% Outter Surface
Ind_out=find(((X.^2 + Y.^2 + Z.^2) < R) & (0 <Z & Z<(sqrt(R^2-(X.^2 +
 Y.^2)))));
Logic_out= ismember(1:size(X(:)) , Ind_out);
Logic_out=reshape(Logic_out,size(X));

% Inner surface
Ind_in=find((X.^2 + Y.^2 + Z.^2) < r);
Logic_in= ismember(1:size(X(:)) , Ind_in);
Logic_in=reshape(Logic_in,size(X));

% Selecting domain of intrest
keepLogic= and (Logic_out, ~Logic_in);
Sn=double(keepLogic);
Sn(keepLogic)=S(keepLogic);
sv3(Sn); %Visualize Sn field

% isosurface over the spherical shell
[F,V]=isosurface(X,Y,Z,Sn,levelset);
C=zeros(size(F,1),1);

% Using grouping to keep only largest group
groupOptStruct.outputType='label';
[G,~,groupSize]=tesgroup(F,groupOptStruct); %Group connected faces
[~,indKeep]=max(groupSize); %Index of largest group

% Keep only largest group
F=F(G==indKeep,:); %Trim faces
C=C(G==indKeep,:); %Trim color data
[F,V]=patchCleanUnused(F,V); %Remove unused nodes

% Visualizing geometry
cFigure; hold on;
title('Spherical Shell Diamond-Lattice','FontSize', fontSize)
gpatch(F,V,[0.75, 0.75, 0],'none', 1);
axisGeom(gca,fontSize); axis off;
camlight headlight;
drawnow;
```



Spherical Shell Diamond-Lattice



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