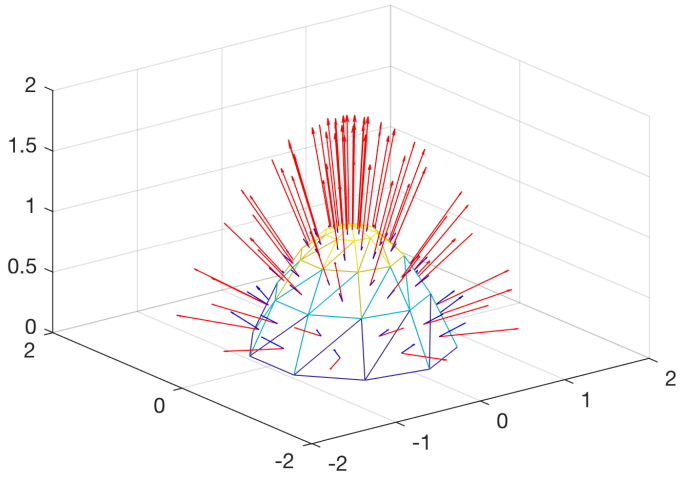
UBC MECH 222: MATLAB Computer Lab 7

Flux integrals over triangulated parametric surfaces




```
[T,X,Y,Z] = triangulate(@paraboloid,[0,1],[0,2*pi],[5,10]);
total_flux = flux_integral(T,X,Y,Z,@(x,y,z) [x,y,z]);

function p = paraboloid(r,theta)
    x = r.*cos(theta);
    y = r.*sin(theta);
    z = 1 - r.^2;
    p = [x,y,z];
end
```

```
total_flux =

    8.4968
```

Instructions

Write a function called `flux_integral` which takes 5 input parameters:

- ☐ `T` is a matrix of vertex indices of a triangulation
- ☐ `X` is the vector of x coordinates of the vertices
- ☐ `Y` is the vector of y coordinates of the vertices
- ☐ `Z` is the vector of z coordinates of the vertices
- ☐ `F` is a function handle defining a vector field $\mathbf{F} : \mathbb{R}^3 \to \mathbb{R}^3$

The function performs the following tasks:

- ☐ Use `trimesh` to plot the triangulated surface defined by `T`, `X`, `Y` and `Z`
- ☐ Let A_i, B_i and C_i be the vertices of triangle T_i in the triangulation and let $\mathbf{n}_i$ be the normal vector to the face with *upward* orientation (ie. $\mathbf{n}_i \cdot (0, 0, 1) \geq 0$). Let P_i be the centroid of the triangle
$$P_i = \frac{A_i + B_i + C_i}{3}$$
For each triangle T_i in the triangulation, use `quiver3` to plot the vectors $\mathbf{n}_i$ and $\mathbf{F}(P_i)$ with their tails at P_i.
- ☐ Approximate the flux integral
$$\iint_S \mathbf{F} \cdot d\mathbf{S}$$
where S is the triangulated surface with *upward* orientation by computing the sum
$$\sum_i \mathbf{F}(P_i) \cdot \mathbf{n}_i$$

Write comments at the beginning of your function to describe its purpose, inputs, outputs and **include your name and student number**. When you are satisfied with your function, submit your M-file (called `flux_integral.m`) to Connect. This lab is an extension of Computer Lab 5 on triangulated parametric surfaces. You may copy and modify your m-file from Lab 5 to complete this lab.