Let $\Omega \subset \mathbb{R}^3$ be an union of 7 spheres (radius R_2), 3 torus (radius R_1 with tube of radius r) and 3 cylinders (radius r). The meshes can be obtained by using `gmsh` (version >= 3.0.0) with the file `construction02.geo`.

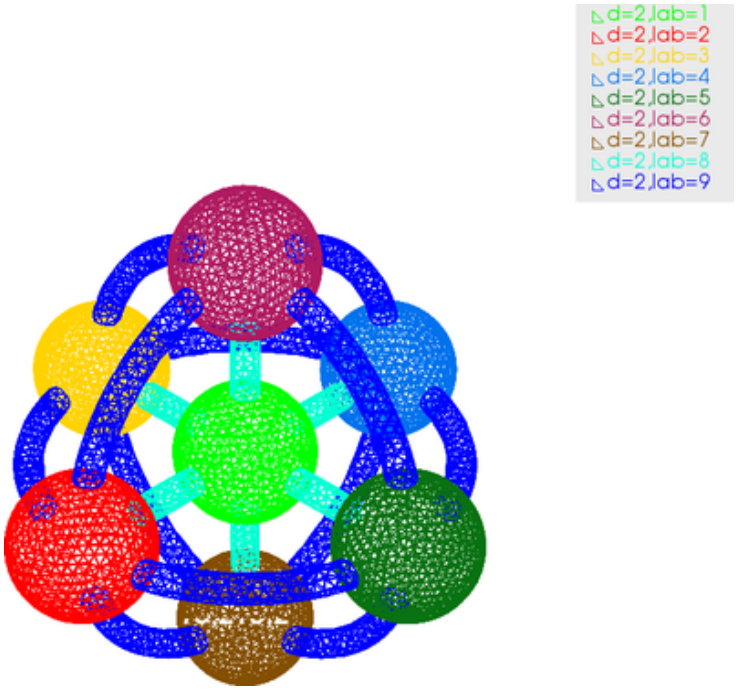

Figure 1: 3d mesh boundaries

The eigenvalue problem to solve is the following

Usual EBVP 1 : 3D construction with Dirichlet boundary condition on Γ_1

Find $(\kappa, \boldsymbol{u}) = \mathbb{K} \times \mathrm{H}^1(\Omega)^3$ such that

$$\begin{aligned} -\operatorname{div}(\boldsymbol{\sigma}(\boldsymbol{u})) &= \kappa\rho\boldsymbol{u}, \quad \text{in } \Omega \\ \boldsymbol{\sigma}(\boldsymbol{u}).\boldsymbol{n} &= \boldsymbol{0} \quad \text{on } \bigcup_{l=2}^{9} \Gamma_l, \\ \boldsymbol{u} &= \boldsymbol{0} \quad \text{on } \Gamma_1. \end{aligned}$$

The geometrical parameters, in millimeters, are $R_1 = 500$, $R_2 = 100$ and $r = 20$. The isotropic material is made of aluminium and so its Poisson's ratio ν is 0.334, its Young's modulus E is 7.10×10^7 kg.s^{-2}.mm^{-1} and its density ρ is 2.77×10^{-6} kg.mm^{-3}.

One can use the `run` function of the `fc_vfemp1_eigs.examples.LinearElasticity_construction02` module to solve this eigenvalue BVP. The twenty-four first eigenfunctions given by the following command are represented in Figure **??**.

```
from fc_vfemp1_eigs.examples.LinearElasticity_construction02 import run
res=run(N=50,R1=500,R2=100,r=20,nu=0.334,E=71e6,rho=2.77e-6,
    Dirichlet=[1],k=16,colormap='jet')
```

GIT : commit 3d0d93d5ce0c0eaf0993a6a45f90768393720c69 Date: Mon Jun 19 15:22:13 2017 +0200

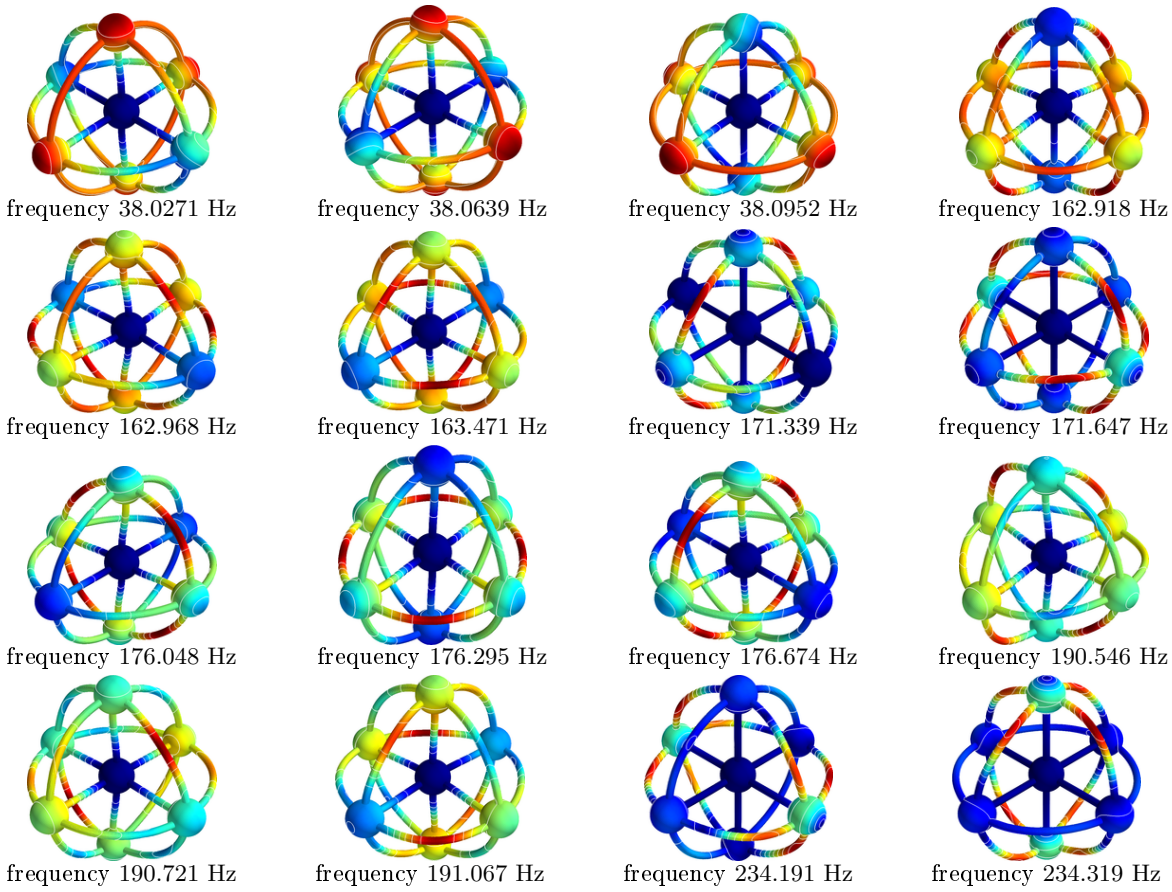

Figure 2: 3D construction with Neumann boundary conditions on $\Gamma_2 \cup \Gamma_3$ and Dirichlet on Γ_1: eigenvectors of the smallest magnitude eigenvalues streched to a maximum of 20 mm.