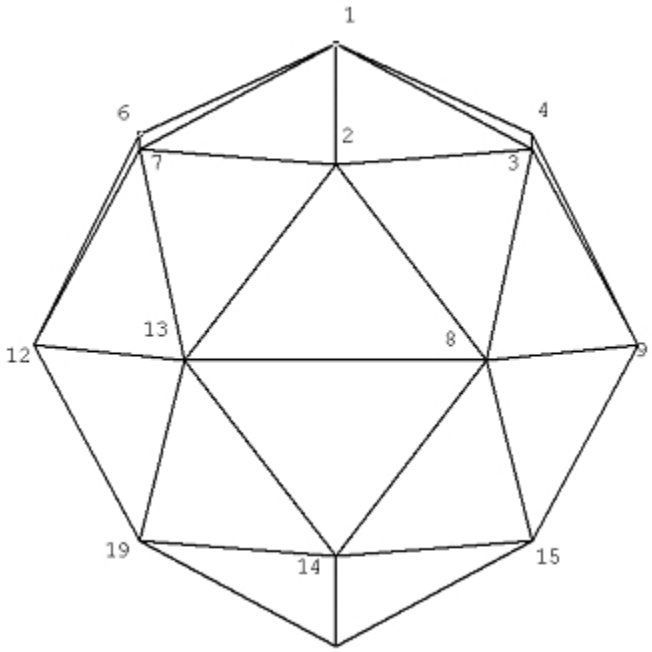
Representation of an axisymmetric surface by triangular panels

For solving the three-dimensional problems by the boundary element method, the boundaries must be represented in the form of a set of planar triangles, and this is the simplest form of representing a general 3D surface. For closed boundaries, in order that the normal to the boundary points *outward* rather than *inward* the three nodes that define each element must be listed in the anti-clockwise direction when it is viewed from just outside the surface. Thus when the nodes that make up a triangular panel are listed in turn in the routine NORM3 in the file GEOM3D, (in Fortran[1], Excel-VBA[2] and in Matlab[3]) the outward normal is calculated.

The following diagram illustrates a typical boundary represented and approximated by a set of triangular panels, a sphere represented by 36 planar triangles and 20 vertices. In this example the representation of the boundary is quite a severe approximation on the original boundary and hence some corresponding loss of accuracy should be expected in the BEM solution.



Representation of the sphere by flat triangular panels.

In order to pass the description of the boundary to the subroutines it is represented by the two table. The first table lists the (x, y, z) coordinates of the vertices and is identified by the real array '*vertex*'. The second table lists the index of the three vertices that define each panel and is identified by the integer array 'selv'.

[1]Fortran: GEOM3D.FOR.FOR
[2]Excel-VBA: GEOM_xlsm.pdf
[3]Matlab: GEOM_m.pdf

Table 2.C: Vertices of approximate sphere boundary (VERTEX)							
Index	x	y	z	Index	x	y	z
1	0.000	0.000	1.000	11	-0.500	-0.866	0.000
2	0.000	0.745	0.667	12	-1.000	0.000	0.000
3	0.645	0.372	0.667	13	-0.500	0.866	0.000
4	0.645	-0.372	0.667	14	0.000	0.745	-0.667
5	0.000	-0.745	0.667	15	0.645	0.372	-0.667
6	-0.645	-0.372	0.667	16	0.645	-0.372	-0.667
7	-0.645	0.372	0.667	17	0.000	-0.745	-0.667
8	0.500	0.866	0.000	18	-0.645	-0.372	-0.667
9	1.000	0.000	0.000	18	-0.645	0.372	-0.667
10	0.500	-0.866	0.000	20	0.000	0.000	1.000

Table 2.D: Panels that constitute the sphere (SELV))							
Index	Vertex 1	Vertex 2	Vertex 3	Index	Vertex 1	Vertex 2	Vertex 3
1	1	3	2	18	8	15	14
2	1	4	3	19	8	9	15
3	1	5	4	20	9	16	15
4	1	6	5	22	9	10	16
5	1	7	6	23	10	17	16
6	1	2	7	24	10	11	17
7	2	3	8	25	11	18	17
8	3	9	8	26	11	12	18
9	3	4	9	27	12	19	18
10	4	10	9	28	12	13	19
11	4	5	10	29	13	14	19
12	5	11	10	30	13	8	14
13	5	6	11	31	14	15	20
14	6	12	11	32	15	16	20
15	6	7	12	33	16	17	20
16	7	13	12	34	17	18	20
17	7	2	13	35	18	19	20
18	2	8	13	36	19	14	20

Test problems using these boundary definition can be found on www.boundary-element-method.com for solving Laplace's equation[4], the Helmholtz Equation[5] or for acoustic problems[6].

[4] Laplace's Equation
[5] Helmholtz Equation
[6] The Boundary Element Method in Acoustics