In [1]:
```
from openscad1 import *
# set_printoptions(suppress=True)
# from IPython.display import display, HTML
# display(HTML("<style>.container { width:100% !important; }</style>"))
```

Table of Contents (alphabetic ordered)

- **2W-wheel** : 2-wheeler wheel cmpletely designed in openscad
- **3d-knots** : various interesting 3d knots
- **4W-wheel** : 4-wheeler wheel concept designed in openscad
- **align_sol(sol,ang=10)** : same as align_sec but for solid with multiple slices
- **align_sol_1(sol)**: same a align_sec_1 but for a solid with multiple slices
- **ang(x,y)**: calculates the angle with base(x) and perpendicular(y) distances. if x<0 and y>0 the angle will be 90<x<180)
- **ang_2lineccw(p0,p1,p2)** : ccw angle of the line p0p2 from base line p0p1
- **ang_2linecw(p0,p1,p2)** : cw angle of the line p0p2 from base line p0p1
- **arc(radius=0,start_angle=0,end_angle=0,cp=[0,0],s=20)**: function for calculating 2d arc. 'cp': center point of the arc. 's': number of segments in the arc
- **arc_2p(p1,p2,r,cw=1,s=20)**: calculates arc with 2 given points.cw or ccw will change the arc, also this generates the shortest distance arc
- **arc_2p_3d(n1,p0,p1,r,cw=1,s=20)** : draws an arc with 2 points and normal in 3d space
- **arc_2p_3d_cp(n1,p0,p1,r,cw=1)** : finds center point of the arc with 2 points and a normal
- **arc_2p_cp(p1,p2,r,cw=-1)** : calculates the center point of an arc based on 2 given points, cw or ccw dirctions are important to calculate the correct center point
- **arc_3d(v=[0,0,1],r=1,theta1=0,theta2=360,cw=-1,s=50)** : calculates the arc in 3d space w.r.t. plane defined by normal vector 'v1', radius 'r1', start and end angles, cw or ccw and number of segments 's'
- **arc_3p(p1,p2,p3,s=30)**: function to draw arc with 3 known points 'p1','p2','p3'. 's' is the number of segments of the arc
- **arc_3p_3d(points,s=20)** : draws an arc through the 3 points list. 's' is the number of segments of the circle
- **arc_long_2p(p1,p2,r,cw=1,s=20)**: long arc with 2 points 'p1,p2' with radius 'r' and with orientation clockwise (1) or counterclock wise(-1)
- **arc_long_2p_3d(n1,p0,p1,r,cw=1,s=20)** : draws a long arc with 2 points and normal
- **artifact** :
- **axis_rot(axis,solid,angle)**: rotate a solid around an axis
- **axis_rot_1(sol,ax1,loc1,theta)**: rotate a solid on any pivot point 'loc1' with axis of rotation 'ax1' by an angle 'theta'
- **axis_rot_o(axis,solid,angle)**: rotate a solid around an axis considering the solid is centered at origin
- **back-camera-clamp** :
- **ball-bearing** :
- **bb(prism)**: function to find the bounding box dimensions of a prism
- **bezier(p,s=10)**: bezier curve defined by points 'p' and number of segments 's'
- **bottle-with-cut-design** :

- **bspline_cubic(px,s=10)** : draws a cubic bspline curve for the given control points. 's' defines the number of points in a bspline curve as (len(px)-2)*s
- **business-card-holder** :
- **c_hull(pnt)**: function to calculate convex hull for a list of points 'pnt'
- **c2ro(sol,s)** : change the orientation of points of a cylinder from circular to rectangular orientation. 'sol': is a cylindrical type 3d shape. 's': number of segments required between each straight line segments
- **c2t3(p)** : function to convert 2d to 3d, it just adds the z-coordinate to the points list
- **c3t2(a)**: function to convert 3d to 2d, it just removes the z-coordinate from the points list
- **cam-profle** :
- **chimney-panel-support** :
- **cir_2p(p1,p2,r,cw=1,s=20)** : circle with 2 points 'p1,p2' with radius 'r' and with orientation clockwise (1) or counterclock wise(-1)
- **cir_3p(p1,p2,p3,s=30)**: function to draw circle with 3 known points 'p1','p2','p3'. 's' is the number of segments of the circle
- **cir_3p_3d(points,s=20)**: draws a circle through the 3 points list. 's' is the number of segments of the circle
- **cir_p_t(cir,p)**: circle to point tangent line (point should be outside the circle)
- **circle(r,cp=[0,0],s=50)** : function for creating points in circle with radius "r", center point "cp" and number of segments "s"
- **coil-example** :
- **concave_hull(p_l,k=3)**:calculate the concave hull of a random list of points. larger number for 'k' will give smoother shape
- **cone-through-parameteric-equation** :
- **convert_3lines2fillet(pnt1,pnt2,pnt3,f=1.9,s=10)** : Develops a fillet with 3 list of points (pnt1,pnt2,pnt3) in 3d space, f: is a factor which can be reduced to 1.5 in case of self intersection observed, s: number of segments in the fillet, increase the segments in case finer model is required
- **convert_3lines2fillet_closed(pnt1,pnt2,pnt3,f=1.9,s=10)** : Develops a fillet with 3 list of points (pnt1,pnt2,pnt3) in 3d space, f: is a factor which can be reduced to 1.5 in case of self intersection observed, s: number of segments in the fillet, increase the segments in case finer model is required
- **convert_secv(sec)** : function removes all the radiuses from the section 'sec' where points are ccw
- **convert_secv1(sec)** : function removes all the radiuses from the section 'sec'
- **convert_secv2(sec,d)** : function removes all the radiuses from the section 'sec' where points are cw. 'd' should be > the maximum radius at cw corner to give the right results
- **convex(sec)** : function to check whether a section is convex or not
- **convex_hull(pnts)**: calculates convex hull for a list of points 'pnts'
- **corner_radius(sec,s)** : function to create section with corner radiuses)
- **cosinewave(l,n,a,p)** : creates a cosinewave with length 'l', number of cycles 'n' amplitude 'a' and number of points 'p'
- **cp_3p(p1,p2,p3)** : function to calculate center point of a circle created from 3 known points 'p1','p2','p3'
- **cp_arc(arc1)** : function returns the center point of a given circle or arc
- **cp_cir_3d(cir)** : center point of circle with atleast 3 known list of 'points' in 3d space
- **cpo(prism)** : function to change the orientation of the points of the prism

- **cs1(sec,d)**: creates a cleaning section for removing excess points for offseting a section 'sec' with offset distance 'd'
- **cube(s,center=False)** : function to draw cube with size 's'
- **cut_plane(nv=[0,0,1],size=[5,5],thickness=10,trns1=0,trns2=0,trns3=0)** : function for defining a solid (cutting plane) oriented as per the defined normal vector, nv: normal vector for defining plane orientation of the section, thickness: thickness or height of the cutting plane, trns1: translate the solid in the direction of normal vector 'nv', trns2: translate the solid in the direction 'right' to the normal vector 'nv', trns3: translate the solid in the direction 'up' to the normal vector 'nv', '-ve' values given to the trns1,trns2,trns3 will translate the solid in the reverse direction
- **cw(sec)** : function to identify if an enclosed section is clockwise(cw) or counterclockwise(ccw). this returns 1 if section is clockwise and -1 if it is counterclockwise
- **cwv(sec)** : function to identify whether each point in a section is clockwise or counter clockwise.
- **cylinder(r1=1,r2=1,h=1,cp=[0,0],s=50,r=0,d=0,d1=0,d2=0,center=False)** : function for creating cylinder, cone
- **cylinder-with-rectangular-pocket** :
- **cylinder-with-star-pocket** :
- **cytz(path)**: converts 'y' points to 'z' points in a 2d list of points
- **drill-bit** :
- **e_wave(l,a,w,t)** : create a graph of exponential function a*e^-(wt) where, w: omega, t: time steps, a: amplitude, l: length of time
- **end_cap(sol,r=1,s=10)** : function to draw radius at the ends of 'path_extrude_open' models. sol: path extruded solid, r: radius at the ends, s: segments of the radius
- **equidistant_path(path,s=10)** : divides a path in to equally spaced points
- **equidistant_pathc(path,s=10)** : divides a closed path in to equally spaced points
- **equivalent_rot_axis(r1=[])** : function returns an equivalent axis for rotation and angle of rotation for a sequence of rotations given by list 'r1'
- **example-of-rounding** :
- **exclude_points(list1,list_to_exclude)** : function to remove points from a list
- **f_prism(sec,path)** : creates a solid or prism with a 2d section and a 2d path. This is a much faster version of function prism, but may not work with few shapes correctly)
- **faces(l,m)** : calculate the faces for the vertices with shape l x m with first and the last end closed
- **faces_1(l,m)** : calculate the faces for the vertices with shape l x m with first and the last end open
- **fillet_2cir(r1,r2,c1,c2,r,s=50)** : fillet between 2 circles with radius 'r1' and 'r2' and center points 'c1' and 'c2' and 'r' is the radius of the fillet
- **fillet_3p_3d(p0,p1,p2,r,s)** : fillet with 3 known points 'p0,p1,p2' in 3d space
- **fillet_3p_3d_cp(p0,p1,p2,r)** : center point 'cp' of the fillet with 3 known points 'p0,p1,p2' in 3d space. 'r' is the radius of fillet
- **fillet_line_circle(l1,c1,r2,cw=-1,option=0,s=50)** : function to draw a fillet between a line and a circle, option can be '0' or '1' to flip the fillet from one side to another, 's' is the number of segments in the arc
- **filleto_2cir(r1,r2,c1,c2,r,s=50)** : fillet between 2 circles with radius 'r1' and 'r2' and center points 'c1' and 'c2' and 'r' is the radius of the fillet. This is an open fillet where first or the second fillet can be called based on requirement
- **flip(sec)** : flips the sequence of a list or list of points
- **gcd(a,b)** : calculates greatest common divisor for 2 numbers
- **glass-model** :

- **handling-trolley** :
- **helix(radius=10,pitch=10, number_of_coils=1, step_angle=1)** : creates helix
- **honeycomb(r,n1,n2)** : function to draw a honeycomb structure with radius 'r', n1: number of hexagons in 1 layer, n2: number of layers
- **i_line_fillet(sol1,sol2,ip,r1,r2,s=20,o=0)** : calculates a fillet at the intersection of 2 solids when the intersection points 'ip' are separately defined. r1 and r2 would be same in most of the cases, but the signs can be different depending on which side the fillet is required. r1 is the distance by which intersection line offsets on sol2 and similarly r2 is on sol1
- **i_line_planes(p1,p2)**: intersection line between 2 planes 'p1' and 'p2'
- **i_p_n(sol,i_p)** : calculates normal at the intersection points, sol: solid on which the normal is required, i_p: list of intersection points between 2 solids
- **i_p_p(sol,i_p,r)** : function to project the intersection point on the cutting lines based on the distance 'r'
- **i_p_t(path)** : function to calculate tangent vectors to a given path
- **intersections(segments)** : calculates the intersections of adjacent line segments only
- **ip(prism,prism1,side=-1)**: function to calculate intersection point between two 3d prisms. "prism" is the 3d object which is intersected with "prism1". side: when a ray intersects a solid it can intersect at 2 locations, if the ray is travelling from outside, in that case if '0' is given meaning only the first intersection point is considered, and in case '-1' is given meaning the last intersection point will be considered.)
- **ip_fillet(sol1,sol2,r1,r2,s=20,o=0)** : calculates a fillet at the intersection of 2 solids. r1 and r2 would be same in most of the cases, but the signs can be different depending on which side the fillet is required. r1 is the distance by which intersection line offsets on sol2 and similarly r2 is on sol1
- **ip_sol2line(sol,line)** : function to calculate intersection point between a 3d solid and a line. "sol" is the 3d object which is intersected with a "line". in case there are more than 1 intersections of the line with the solid/ prism ip(sol,line)[0] will give the first intersection point and ip(sol,line)[-1] will give the last intersection point
- **ip_sol2sol(sol,sol1,n=0)** : function to find the intersection point between 2 solids. this function is to be used where the cutting lines of sol1 are intersecting sol at more than 1 times.sol: solid which is intersected. sol1: this intersects the solid 'sol'. n: if the first intersection points of all the cutting lines are to be considered, value of n should be '0'. if the last intersection points of all the cutting lines are to be considered, value of 'n' should be set to '-1'
- **ip_triangle(sol1,p0)** : finds the trianle where the intersection point "p0" lies in a solid "sol1"
- **iterative-approach-towards-creating-fillets** :
- **l_cir_ip(line,cir)** : line circle intersection point
- **l_len(l)** : calculates length of a line 'l'
- **l_lenv(l)** : calculates sum of lengths of all the segments in a line 'l' considering the section is closed
- **l_lenv_o(l)** : calculates sum of lengths of all the segments in a line 'l' considering the section is open
- **l_sec_ip(line,sec)** : line and section intersection point
- **l_sec_ip_3d(sec,line)** : finds the intersection points between a section in 3d space and a line in 3d space
- **l2l_intersection(l1,l2)** : function to find the intersection point between 2 lines in 3d space
- **lamp** :
- **lcm** : calculates least common multiple for 2 numbers

- **lexicographic_sort_xy(p)** : function sorts the points list 'p' first with x and then with y smallest to largest
- **lexicographic_sort_yx(p)** : function sorts the points list 'p' first with y and then with x smallest to largest
- **linear_extrude(sec,h=1,a=0,steps=1)** : function to linear extrude a section where, se/users/sanjeevprabhakar section to extrude, h: height of the extrusion, a: angle of twist while extruding, steps: number of steps in each angular extrusion
- **list_r(sec)** : function list the corner radiuses of a given section (only where the radius is specified)
- **ls(line,n)**: plots 'n' points in a straight line)
- **m10** :
- **m35** :
- **m39** :
- **max_r(sec)** : finds the maximum radius of a given closed section)
- **mobile-phone-stand** :
- **multiple_sec_extrude(path_points=[],radiuses_list=[],sections_list=[],option=0,s=10)**: path_points: are the points at which sections needs to be placed,radiuses: radius required at each path_point. this can be '0' in case no radius required in the path, sections_list= list of sections required at each path_points. same section can be provided for various path_points as well, option: can be '0' in case the number of points in each section do not match or '1' in case number of points for each section are same, s: in case value of radiuses is provided 's' is the number of segments in that path curve
- **normals_along_path** :
- **nv(p)** : finds the normal vector for a given points in a 3d plane
- **o_3d(i_p,sol,r,o=0)** : function to offset the intersection points 'i_p' on a solid 'sol' by distance 'r'. option 'o' can have values '0' or '1' and changes the direction of offset
- **o_p_p(sol,i_p,d)**: calculates projected points on the surface of a solid , sol: solid on which the points to be projected, i_p: list of points in 3d space near the solid, d: approximate distance of the points from the surface, specifying too big distance , may create multiple projection of the same point on the solid
- **o_solid(nv=[0,0,1],sec=[],thickness=10,trns1=0,trns2=0,trns3=0, theta=[0,0,0])** : function for defining a solid with any defined section. solid gets oriented as per the defined normal vector, nv: normal vector for defining plane orientation of the section, se/users/sanjeevprabhakar cross section of the solid, thickness: thickness or height of the solid, trns1: translate the solid in the direction of normal vector 'nv', trns2: translate the solid in the direction 'right' to the normal vector 'nv', trns3: translate the solid in the direction 'up' to the normal vector 'nv', '-ve' values given to the trns1,trns2,trns3 will translate the solid in the reverse direction , theta: rotate the section around axis fox example if nv is [1,0,0] or x-axis, the sequence of rotation will be x, y ,z axis
- **offset(sec,r)** : calculates offset for a section 'sec' by amount 'r'
- **offset_3d(sec,d)** : offsets an enclosed section in 3d space, in case the section is in 1 plane, se/users/sanjeevprabhakar section in 3d space, d: offset distance -ve sign means inner offset and +ve sign is outer offset
- **offset_points(sec,r)** : function to calculate offset of a list of 2d points. in defining sections, providing corner radius is a must
- **offset_points_ccw(sec,r)**: function to offset only those points which are counter clockwise
- **offset_points_cw(sec,r)** : function to offset only those points which are clockwise
- **offset_seg_cw(sec,r)** : function offsets the segment only when the point is clockwise

- **offset_segv(sec,d)** : function makes the segments of the original section and offset each segment by a distance 'd'
- **orthos_along_path(path,scale=1)** :
- **oset(sec,r)** : function to draw offset of a section 'sec' with distance 'r'
- **p_cir_t(p,cir)** : point to circle tangent line (point should be outside the circle)
- **p2p_intersecion_line(pa,pb)** : function to calculate intersection line between 2 planes in 3d space
- **path_extrude_closed(sec,path,twist=0)** : function to extrude a closed section to a closed path. closed path means the path provided has it's first and the last point same example a circle
- **path_extrude_open(sec,path,twist=0)**: function to extrude a closed section to an open path. twist can be set either to '0' or '1' depending on the shape produced
- **path_offset(path,d)** : function to offset a 'path' by 'd' distance
- **pies1(sec,pnts)** : function to find points 'pnts' which are inside an enclosed section 'sec'
- **plane(nv,size=[100,100])** : plane defined by normal 'nv' and 'size'
- **pntsnfaces(bead2)** : function returns points and faces of a prism
- **points_inside_offset_surround(sec,sec2,r)** : function returns points in a list 'sec2' which are inside the offset surround of a section 'sec' with offset radius of 'r'
- **ppesec(p0,sec)**: point's projection on an enclosed 3d section
- **ppplane(p0,v1,loc)** : function to find projected points of a given list of points 'p0' on a plane defined by normal'v1' and location 'loc'
- **prism(sec,path)** : function to make a prism with combination of 2d section and 2d path
- **pts(p)** : calculates the cumulative sum of 2d list of points 'p'
- **pts1(p)**: 'p' is a list of points. function calculates the cumulative sum of x,y values in the list while z value remains the same. this is mainly used in function corner_radius(pl,s).
- **q(vector=[1,0,0],point=[0,5,0],theta=0)** : function to rotate a point around a vector(axis) with angle theta)
- **q_rot(s,pl)** : function to rotate a group of points "pl" around a series of axis with defined angles
- **q_rot2d(theta,pl)** : function to rotate a 2d point or 2d points list by an angle theta around z-axis
- **r_sec(r1,r2,cp1,cp2)** : creates a rounded section around a line defined by points 'cp1' and 'cp2'. radius around 'cp1' is 'r1' and radius around 'cp2' is 'r2'
- **rounding-various-rounded-cubes** :
- **rsz2d(sec,rsz)** : function to resize a 2d section to dimensions 'rsz'. resized section will be placed on bottom center of the original section
- **rsz2dc(sec,rsz)** : function to resize a 2d section to dimensions 'rsz'. resized section will be placed in center of the original section
- **rsz3d(prism,rsz)** : function to resize a 'prism' to dimensions 'rsz'. bottom left corner of both the prisms would be same
- **rsz3dc(prism,rsz)** : function to resize a 'prism' to dimensions 'rsz'. resized prism will be placed in the center of the original prism or center point of both the prisms will be same
- **s_int(s)** : calulates the self intersection points of a list of line segments 's'. it also picks the points in case the 2 lines are just connected at 1 point and are not crossing
- **s_int1(s)**: calcultes the self intersecting segments such that there is a complete intersection and not only end points touching
- **samsung-tab-s6-holder** :
- **scl2d(sec,sl)**: scale a 2d section to a scaling factor 'sl')

- **scl2d_c(sec,sl)** : scale a 2d section such that the center of original and scaled section is same)
- **scl3d(p,s)** : scale any 3d prism to a scaling factor 's')
- **sec2vector(v1=[1,0,0],sec=[])** : function to align a section 'sec' with a vector 'v1'
- **sinewave(l,n,a,p)** : creates a sinewave with length 'l', number of cycles 'n' amplitude 'a' and number of points 'p'
- **sinwave-box** :
- **sl_int(sec,line)** : function to find intersection between an enclosed section in 3d space and a line
- **slice_sol(sol,n=10)**: function to slice a solid with 'n' intermediate steps
- **sol2path(sol,path)**: function to extrude a solid along a path
- **sol2vector(v1=[],sol=[],loc=[0,0,0])**: orients a solid as per a given vector
- **sort_points(sec,list1)** : function picks the nearest point of a section from a reference section and matches the length of points for the 2 compared sections
- **sphere(r=0,cp=[0,0,0],s=50)** : function to draw sphere with radius 'r' , center point 'cp' and number of segments 's'
- **sphere-through-parameteric-equation** :
- **sunflower** :
- **surf_base(surf,h=0)** : creates a solid from any surface, 'h' is the height of the base of the surface
- **surf_extrude(sec,path)** : extrudes an open section 'sec' to a 3d 'path' to create surface
- **surf_extrudef(surf,t=-.05)** : surface with a polyline 2d sketch and a 3d path. thickness of the surface can be set with parameter "t". positive and negative value creates thickness towards +z and -z directions respectively
- **surf_offset(sec,d)** : function to offset the surface 'sec' by a distance 'd'
- **surface_for_fillet(sol1=[],sol2=[],factor1=50,factor2=10,factor3=1,factor4=100,dia=40)**: sol1: Solid on which the surface needs to be created. sol2: Intersecting solid. factor1: number of segments in the circle. factor2: number of layers or slices of surface. factor3: decides the size of the surface lower value means bigger size. value can be set between 1 to any number. factor4: any high number should be ok like maybe 100 or greater, basically greater than the bounding box dimension of the "sol1". dia: diameter around the solid 2 where surfavce needs to be created
- **surface_offset(surf,d)** : offsets the surface by an amount 'd'
- **surface_thicken(surf,d)** : Thickens the surface by an amount 'd'
- **SurfaceFrom3LinesInDifferentPlanes(w1,w2,w3,o=1)** : create surface with 3 lines in different planes
- **swp_prism_h(prism_big,prism_small)** : creats a hollow prism with 2 similar prisms (1 big and 1 smaller)
- **t_cir_tarc(r1,r2,cp1,cp2,r,side=0,s=50)** : function draws a arc which is tangent to 2 circles defined by radiuses 'r1' and 'r2' and center points 'cp1' and 'cp2'. 's' is the number of segments of the tangent arc. 'r' is the radius of the tangent arc (it should be >= (r1+r2+center distance of 2 circles)/2). 'side' there are 2 sides of the circles where the arc could be created defined by '0' and '1'
- **tangents_along_path(path,scale=1)** :
- **tcct(r1,r2,cp1,cp2,cw=-1)** : two circle cross tangent
- **tctp(r1,r2,cp1,cp2)** : 2 circle tangent points (one side) r1 and r2 are the radius of 2 circles and cp1 and cp2 are the center points)
- **tctpf(r1,r2,cp1,cp2)** : 2 circle tangent point full (both the sides))
- **torus-through-parameteric-equation** :

- **translate(p,sec)** : translates a prism or section by [x,y,z] distance
- **translate_2d(p,sec)** : function to translate a group of points "sec" by "p" distance defined in [x,y]
- **v_sec_extrude(sec,path,o)** : extrude a section 'sec' through a path 'path' . section will vary from start to end such that at the end the section will be offset by 'o' distance
- **wrap_around** : complex function see the example to understand

surf_extrude

In [11]:

```
# example of surf_extrude
t0=time.time()

sec2=corner_radius(pts1([[-25,0],[10,5,5],[10,-3,10],[10,5,5],[10,-8,7],[10,1]]),10)
path2=cytz(corner_radius(pts1([[-35,5,0],[10,8,20],[20,-5,10],[20,8,20],[10,-9,20],[10,1,0]])

surf2=surf_extrude(sec2,path2)
# surf3=surface_offset(surf2,-1)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>


{swp_surf(surf2)}
//color("grey"){swp_surf(surf3)}

''')
t1=time.time()
total=t1-t0
total
```

Out[11]:

```
0.07369565963745117
```

surf_extrudef

surface_thicken

In [8]:
```
# example of surf_extrudef
t0=time.time()

sec2=corner_radius(pts1([[-25,0],[10,5,5],[10,-3,10],[10,5,5],[10,-8,7],[10,1]]),10)
path2=cytz(corner_radius(pts1([[-35,5,0],[10,8,20],[20,-5,10],[20,8,20],[10,-9,20],[10,1,0]])
surf2=surf_extrude(sec2,path2)
surf3=surf_extrudef(surf2,t=-1)
surf3=surface_thicken(surf2,-1)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(surf3)}
//color("blue")for(p={surf3})p_line3dc(p,.1,rec=1);

''')
t1=time.time()
total=t1-t0
total
```

Out[8]:
```
0.32423973083496094
```

fillet_2cir

In [5]:
```
# example of function fillet_2cir
t0=time.time()
fillet=fillet_2cir(r1=5,r2=3,c1=[0,0],c2=[7,0],r=1)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%p_line({circle(5)},.2);
    %p_line({circle(3,[7,0])},.2);
    p_line({fillet},.2);

''')

t1=time.time()
t1-t0
```

Out[5]: 0.005053997039794922

filleto_2cir

In [6]:
```
# example of function filleto_2cir and arc_long_2p
t0=time.time()

fillet=filleto_2cir(r1=10,r2=10,c1=[0,0],c2=[20,0],r=10)
p0,p1,p2,p3=fillet[1][len(fillet[1])-1], fillet[0][0],fillet[0][len(fillet[0])-1],fillet[1][0
cir1=arc_long_2p(p0,p1,10,-1,40)
cir2=arc_long_2p(p2,p3,10,-1,40)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
    //%p_line({circle(10)},.2);
    //%p_line({circle(10,[20,0])},.2);
    color("blue")p_lineo({fillet[0]},.2);
    color("yellow")p_lineo({fillet[1]},.2);
    color("magenta")p_lineo({cir1},.2);
    color("cyan")p_lineo({cir2},.2);


''')
t1=time.time()
t1-t0
```

Out[6]: 0.006121873855590082

corner_radius(sec,s)

In [6]:
```
# example of function corner_radius(pl,s)
t0=time.time()
sec=corner_radius(sec=[[0,0,.5],[10,0,2],[7,15,1]],s=5)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.1);


''')
t1=time.time()
t1-t0
```

Out[6]:
```
0.0046236515045166016
```

translate

In [7]:
```
# example of function translate(p,sec)
t0=time.time()
sec=corner_radius([[0,0,.5],[10,0,2],[7,15,1]],5)
sec1=translate(p=[10,5,3],sec=sec)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.1);
color("magenta")p_line3dc({sec1},.1);


''')
t1=time.time()
t1-t0
```

Out[7]:
```
0.003881216049194336
```

scl2d(sec,sl)

In [8]:
```
# example of function scl2d(sec,sl)
t0=time.time()
sec=corner_radius([[0,0,.5],[10,0,2],[7,15,1]],5)
sec1=scl2d(sec,.7)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.1);
color("magenta")p_line({sec1},.1);


''')
t1=time.time()
t1-t0
```

Out[8]:
```
0.002565622329711914
```

scl2d_c(sec,sl)

In [9]:
```
# example of function scl2d_c(sec,sl)
t0=time.time()
sec=corner_radius([[0,0,.5],[10,0,2],[7,15,1]],5)
sec1=scl2d_c(sec,.7)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.1);
color("magenta")p_line({sec1},.1);


''')
t1=time.time()
t1-t0
```

Out[9]: 0.010084867477416992

scl3d(p,s)

In [10]:
```
# example of function scl3d(p,s)
t0=time.time()
sec=circle(10);
path=corner_radius(pts1([[2,0],[-2,0,2],[0,10,3],[-3,0]]),5)
sol=prism(sec,path)
sol1=scl3d(sol,.5)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%{swp(sol)}
{swp(sol1)}


''')
```

```
t1=time.time()
t1-t0
```

Out[10]: 0.2651364803314209

ip(prism,prism1)

In [11]:

```
# example of function ip(prism,prism1)
t0=time.time()

sec=circle(10)
path=corner_radius(pts1([[2,0],[-2,0,2],[0,10,3],[-9.9,0]]),5)
p_0=prism(sec,path)
p_1=cylinder(r=3,h=15,s=30)
ip_1=ip(p_0,p_1)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%{swp(p_0)}
%{swp(p_1)}
color("magenta")points({ip_1},.2);
//color("blue")for(p={cpo(p_0)})p_line3d(p,.05);
//color("blue")for(p={cpo(p_1)})p_line3d(p,.05);
''')
t1=time.time()
t1-t0
```

Out[11]: 0.3192763328552246

In [12]:

```
t0=time.time()

sec2=corner_radius(pts1([[-25,0],[10,5,5],[10,-3,10],[10,5,5],[10,-8,7],[10,1]]),10)
path2=cytz(corner_radius(pts1([[-35,5,0],[10,8,20],[20,-5,10],[20,8,20],[10,-9,20],[10,1,0]])
surf2=surf_extrude(sec2,path2)
sol1=linear_extrude(circle(10),30)
# sol1=slice_sol(sol1,10)
i_p1=ip_surf(surf2,sol1)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")p_line3dc({i_p1},.2);
{swp_surf(surf2)}
''')
t1=time.time()
total=t1-t0
total
```

Out[12]:

```
0.18246936798095703
```

tctp(r1,r2,cp1,cp2)

In [15]:

```
# example of function tctp(r1,r2,cp1,cp2)
t0=time.time()
cir1=circle(10)
cir2=circle(5,[15,6])
sec=tctp(r1=10,r2=5,cp1=[0,0],cp2=[15,6]);


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
p_line({cir1},.1);
p_line({cir2},.1);

color("blue")p_line({sec},.1);
color("magenta")points({[sec[1]]},.5);

''')

t1=time.time()
t1-t0
```

Out[15]:

```
0.004054069519042969
```

tctpf(r1,r2,cp1,cp2)

In [16]:

```
# example of function tctpf(r1,r2,cp1,cp2)
t0=time.time()

cir1=circle(10)
cir2=circle(5,[15,6])
sec=tctpf(r1=5,r2=10,cp1=[15,6],cp2=[0,0])


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
p_line({cir1},.1);
p_line({cir2},.1);
color("blue")p_line({sec},.1);


''')
t1=time.time()
t1-t0
```

Out[16]:

```
0.004689931869506836
```

multiple_sec_extrude

In [17]:
```
# example of function multiple_sec_extrude(path_points=[],radiuses_list=[],sections_list=[],o
t0=time.time()

sec1=circle(10)
sec2=square(5,True)
sec3=corner_radius(pts1([[-3.5,-2.5,2.49],[7,0,2.49],[0,5,2.49],[-7,0,2.49]]))
sections=[sec1,sec2,sec3,sec1,sec3]
path=array([[0,0,0],[20,2,5],[-7,25,3],[5,10,30],[-30,15,3]]).cumsum(0)
r=[0,5,7,12,0]

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
//color("blue")for(p={multiple_sec_extrude(path,r,sections,0,20)})p_line3dc(p,.1);
{swp(multiple_sec_extrude(path,r,sections,0,20))}
    ''')
t1=time.time()
t1-t0
```

Out[17]:
```
0.3879821300506592
```

path_extrude_open(sec,path)

In [13]:
```
# example of function path_extrude_open(sec,path)
t0=time.time()
sec=corner_radius(pts1([[0,0,.2],[3,0,.2],[0,2,1],[-3,0,1]]),10)
path=helix(10,2.5,4,5.01)
sol=path_extrude_open(sec,path)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
{swp(sol)}
color("blue")p_line3d({path},.1);
    ''')
```

```
t1=time.time()
t1-t0
```

Out[13]: 0.2358417510986328

path_extrude_closed(sec,path)

In [14]:
```
# example of function path_extrude_closed(sec,path)
t0=time.time()
sec=corner_radius(pts1([[0,0,.2],[3,0,.2],[0,2,1.49],[-3,0,1.49]]),10)
path=c2t3(circle(10))
sol=path_extrude_closed(sec,path)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
{swp_c(sol)}
color("blue")p_line3d({path},.1);
    ''')

t1=time.time()
t1-t0
```

Out[14]: 0.03240633010864258

cylinder

In [15]:
```
# example of function cylinder(r1=1, r2=1, h=1, s=50, r=0, d=0, d1=0, d2=0, center=False) and
t0=time.time()
```

```
sol=cylinder(r1=10,r2=5,h=20)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
{swp(sol)}
    ''')
t1=time.time()
t1-t0
```

Out[15]: 0.0025284290313720703

bezier

In [21]:

```
# example of function bezier(p,s=10)
t0=time.time()
control_points=array([[0,0,0],[10,5,5],[-10,10,20],[-10,5,15],[10,0,10]]).cumsum(0).tolist()
curve=bezier(control_points,50)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line3d({curve},.1);
// control points
color("magenta")points({control_points},.5);
color("cyan")p_line3d({control_points},.05);
    ''')
t1=time.time()
t1-t0
```

Out[21]: 0.0071256160736083984

arc_3d

In [22]:
```
# example of function arc_3d(v=[0,0,1],r=1,theta1=0,theta2=360,cw=-1,s=50)
t0=time.time()
vector=[[0,0,0],[1,0,1]]
arc1=arc_3d(v=[1,0,1],r=3,theta1=0,theta2=270,cw=-1,s=50)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
//arc
color("blue")p_line3d({arc1},.1);
// vector
color("cyan")p_line3d({vector},.1);

    ''')
t1=time.time()
t1-t0
```

Out[22]:
```
0.014594078063964844
```

plane

In [9]:
```
# example of function plane(nv,radius)
t0=time.time()
vector=[[0,0,0],[-3,0,2]]
plane1=plane(nv=[-3,0,2],size=[10,10])

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

//plane
%{swp(plane1)}

// vector
color("magenta")p_line3d({vector},.1);

    ''')
t1=time.time()
t1-t0
```

Out[9]:
```
0.0023140907287597656
```

c_hull

In [16]:
```
#  example of function c_hull(pnt)
t0=time.time()
a=random.random(1000)*(20-5)+5
b=random.random(1000)*(30-10)+10
points=array([a,b]).transpose(1,0).tolist()
sec=c_hull(points)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

points({points},.2);
color("blue")p_line({sec},.05);

    ''')
t1=time.time()
t1-t0
```

Out[16]:
```
0.05178070068359375
```

convex

In [19]:
```
# example of function convex(sec)
t0=time.time()
sec1=corner_radius(pts1([[0,0,.2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
sec2=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)


with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

// not a convex section
color("blue")p_line({sec1},.2);

//convex section
color("magenta")translate([20,0,0])p_line({sec2},.2);

    ''')
t1=time.time()
convex(sec1),convex(sec2),t1-t0
```

Out[19]:
```
(False, True, 0.012557506561279297)
```

cir_p_t

In [26]:
```
# example of function cir_p_t(cir,pnt)
cir=c3t2(translate([20,10,0],circle(10)))
point=[1,30]
tangent_point=cir_p_t(cir,point)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
// "cyan" is the tangent point from circle to some external point ("magenta color")
%p_line({cir},.1);
color("magenta")points({[point]},.5);
color("cyan")points({[tangent_point]},.5);
//color("blue")
%p_line({[point,tangent_point]},.05);
    ''')
```

concave_hull

In [31]:
```
# example of function concave_hull(pnts,x=1,loops=10)
t0=time.time()
a=random.random(1000)*(20-5)+5
b=random.random(1000)*(30-10)+10
points=remove_extra_points(array([a,b]).transpose(1,0))
conc_hull=concave_hull(points,3)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

points({points},.2);
color("blue")p_line3d({conc_hull},.1,1);

    ''')
t1=time.time()
t1-t0
```

Out[31]:
```
0.8620815277099609
```

In [28]:

```
# example of pies1(sec,pnts) and concave_hull
t0=time.time()

a=random.random(10000)*(10-0)+0
b=random.random(10000)*(20-0)+0
c=array([a,b]).transpose(1,0).tolist()


sec=corner_radius(pts1([[1.5,8,.9],[2,0,.9],[0,-3,1.4],[3,0,1.4],[0,4,1.9],[-5,0,2.5],[0,6,2.
               [7,0,2.5],[0,-4,.9],[-2,0,.9],[0,3,1.4],[-3,0,1.4],[0,-4,1.9],
              [5,0,2.5],[0,-6,2.5],[-7,0,2.5]]),20)

pnts=pies1(sec,c)

s1=concave_hull(pnts,20)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

points({pnts},.1);
color("magenta")p_line({s1},.05);



''')
t1=time.time()
t1-t0
```

Out[28]:

```
0.98219895362854
```

path_offset

In [29]:
```
# example of function path_offset(path,d)

path=corner_radius(pts1([[-5,0],[5,0,2],[-1,10,2],[-5,0]]))
path1=path_offset(path,-1)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
// orginal path
color("blue")p_line3d({path},.1,1);
//offset path
color("magenta")p_line3d({path1},.1,1);


    ''')
```

In [30]:
```
# example of function path_offset(path,d)
r=-1
path=corner_radius(pts1([[-5,0],[5,0,2],[-1,10,2],[5,0]]),20)
# path=circle(10)
# path=corner_radius(pts1([[0,0],[10,0,.1],[-10,5,.1],[-10,-5]]),20)

path1=path_offset(path,r)


with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
// orginal path
color("blue")p_lineo({path},.1);
//offset path
color("magenta")p_lineo({path1},.1);

    ''')
```

pntsnfaces

In [31]:
```
# example of function pntsnfaces(bead2)

path=corner_radius(pts1([[-5,0],[5,0,2],[-1,10,2],[-5,0]]))
path1=path_offset(path,-1)
final_path=path+flip(path1)
sec=circle(10)
sol=prism(sec,final_path)

points, faces=pntsnfaces(sol)[0],pntsnfaces(sol)[1]

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

polyhedron({points},{faces},convexity=10);
    ''')
```

offset_points

In [32]:
```
# example of function offset_points(sec,r)
t0=time.time()
sec=corner_radius(pts1([[0,0,.1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)
sec1=offset_points(sec,2)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>


//original points
points({sec},.2);

// offset points
color("blue") points({sec1},.2);


    ''')
t1=time.time()
t1-t0
```

Out[32]:
```
0.013966798782348633
```

In [ ]:
```
set_printoptions(suppress=True)
```

s_int

In [33]:
```
# example of function s_int(s)
t0=time.time()
sec=corner_radius(pts1([[0,0,.1],[7,5,2],[-7,10,2]]),3)
sec1=offset_segv(sec,-1)
self_intersections=s_int(sec1)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

// line segments
color("blue") for (p={sec1}) p_line(p,.05);

// intersection points
color("magenta")points({self_intersections},.2);

    ''')
t1=time.time()
t1-t0
```

Out[33]: 0.015115022659301758

In [34]:
```
# example of function s_int(s)
t0=time.time()
sec=corner_radius(pts1([[0,0,2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),5)
sec=seg(sec)
s=s_int(sec)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
```

```
// line segments
color("blue") for (p={sec}) p_line(p,.05);

// intersection points
color("magenta")points({s},.4);

    ''')
t1=time.time()
t1-t0
```

Out[34]:

```
0.023023128509521484
```

s_int1

In [35]:

```
#  example of function s_int1(s)
t0=time.time()
sec=offset_segv([[0,0],[10,0],[15,7]],-1)
self_intersections=s_int1(sec)
```

```
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

// line segments
color("blue") for (p={sec}) p_line(p,.05);

// intersection points
color("magenta")points({self_intersections},.4);

    ''')
t1=time.time()
t1-t0
```

Out[35]: 0.004305124282836914

offset_seg_cw

In [36]:

```
#  example of function offset_seg_cw(sec,r)
t0=time.time()
sec=sec=corner_radius(pts1([[0,0,2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),5)
sec1=offset_seg_cw(sec,-2)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

// original section
color("blue") points({sec},.2);

// offset segments
color("magenta")points({sec1},.2);

    ''')
t1=time.time()
t1-t0
```

Out[36]: 0.013273000717163086

offset_segv

In [37]:
```
#  example of function offset_segv(sec,r)
t0=time.time()
sec=sec=corner_radius(pts1([[0,0,2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),5)
sec1=offset_segv(sec,-1)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
```

```
// original section
color("blue") points({sec},.2);

// offset segments
color("magenta")for(p={sec1})points(p,.2);

    ''')
t1=time.time()
t1-t0
```

Out[37]:

```
0.009231805801391602
```

In [38]:

```
#  example of another method to offset segment where points are clockwise and example functio
t0=time.time()
sec=corner_radius(pts1([[0,0,2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),5)
sec0=seg(sec)
decision=cwv(sec)
sec1=[path_offset(sec0[i],-2) for i in range(len(sec0)) if decision[i]==1]

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

// original section
color("blue") points({sec},.2);

// offset segments
color("magenta")for(p={sec1})points(p,.2);

    ''')
t1=time.time()
t1-t0
```

Out[38]:

```
0.01769280433654785
```

sort_points

In [39]:
```
#  example of function sort_points(sec,sec1)
t0=time.time()
sec=circle(10)
sec1=corner_radius(pts1([[-2.5,-2.5,1],[5,0,1],[0,5,1],[-5,0,1]]))
sec2=sort_points(sec,sec1)
sec3=cpo([sec2,sec])
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

p_line({sec},.05);
p_line({sec2},.05);
color("blue") for(p={sec3})p_line(p,.1);

    ''')
```

```
t1=time.time()
t1-t0
```

Out[39]: 0.009630918502807617

surf_offset

surface_offset :

Although surface_offset is more accurate function, it takes much longer to calculate the offset as compared to surf_offset

In [13]:

```
# example of function surf_offset(surf,o)

sec=circle(10);
path=corner_radius(pts1([[2,0],[-2,0,2],[0,10,3],[-3,0]]),5)
sol=f_prism(sec,path)
sol1=surf_offset(sol,-1)
sol1=surface_offset(sol,1)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%{swp_c(sol)}
{swp_c(sol1)}
```

```
''')
```

pts1

In [41]:
```
# example of function pts1(p)

sec=corner_radius(pts1([[0,0,1],[10,0,1],[0,5,1],[-10,0,1]]),5)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.05);


''')
```

arc_2p

In [42]:
```
# example of function arc_2p(p1,p2,r,cw=1,s=20)

p1=[2,0]
p2=[0,2]
arc1=arc_2p(p1,p2,2,1,20)

arc2=arc_2p(p1,p2,2,-1,20)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

// arc clockwise
//color("blue")
%p_lineo({arc1},.05);

// arc counter clockwise
//color("magenta")
%p_lineo({arc2},.05);

color("cyan")points({[p1,p2]},.2);

''')
```

arc_long_2p

In [43]:
```
# example of function arc_long_2p(p1,p2,r,cw=1,s=20)

p1=[2,0]
p2=[0,2]
arc1=arc_long_2p(p1,p2,2,1,20)

arc2=arc_long_2p(p1,p2,2,-1,20)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

// arc clockwise
//color("blue")
%p_lineo({arc1},.05);

// arc counter clockwise
//color("magenta")
%p_lineo({arc2},.05);

color("cyan")points({[p1,p2]},.2);

''')
```

arc_2p_cp

In [44]:

```
# example of function arc_2p_cp(p1,p2,r,cw=-1)

p1=[2,0]
p2=[0,2]
arc1=arc_2p(p1,p2,2,1,5)
cp1=arc_2p_cp(p1,p2,2,1)

arc2=arc_2p(p1,p2,2,-1,5)
cp2=arc_2p_cp(p1,p2,2,-1)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

// arc clockwise with center point of the arc
color("blue")
{{p_lineo({arc1},.05);
points({[cp1]},.2);}}

// arc counter clockwise with center point of the arc
//color("magenta")
//{{p_lineo({arc2},.05);
//points({[cp2]},.2);}}
```

```
''')
```

offset

oset

In [7]:

```
# example of function offset(sec,r)

t0=time.time()

# sec=corner_radius(pts1([[0,0,.2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)

# sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),10)
# sec=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),10)
sec=corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7],[-40,0,7
# sec=corner_radius(pts1([[0,0,1],[10,0,1],[0,5,1],[-10,0,1]]),10)
# sec=circle(10)
# sec=pts([[0,0],[10,0],[0,5],[-10,0]])

# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,4.2],[-4.2,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,5.3],[-5.3,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,2],[-2,0]]),20)
os=linspace(-2.5,20,50)
sec1=[oset(sec,i) for i in os] #
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("magenta")for(p={sec1})p_line(p,.1);
color("blue")p_line({sec},.1);

''')
t1=time.time()
t1-t0
```

Out[7]: 10.510061740875244

In [9]:

```
t0=time.time()
r=-2
# sec=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,5],[-7,5,5]]),10)
sec=circle(10,s=200)
sec1=oset(sec,r)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
p_line({sec},.05);

color("magenta")p_line({sec1},.05);
''')

t1=time.time()
t1-t0
```

Out[9]: 0.0160672664642334

In [8]:
```
sec=corner_radius(pts1([[0,0,.1],[10,0,.1],[0,3,.1],[-3,0,.1],[0,3,.1],[-3,0,.1],[0,3,.1],[-4



# sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),40)
# sec=sec=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,5],[-7,5,5]]),20)
# sec=corner_radius(pts1([[-15,0,2.49],[0,15,3],[30,0,3],[0,-15,2.49],[5,0,2.49],[0,20,7],[-4
# sec=circle(10)
d=-3

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
p_line({sec},.05);
color("blue")p_line({oset(sec,d)},.05);
%offset({d})polygon({sec});
''')
```

prism

In [5]:

```
# example of function prism(sec,path) and function swp_prism_h(prism_big, prism_small)
t0=time.time()
sec=corner_radius(pts1([[0,0,.2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
# sec=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)
# sec=corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7],[-40,0
# sec=pts([[0,0],[10,0],[0,5],[-10,0]])
path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,4.2],[-4.2,0]]),20)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,5.2],[-5.2,0]]),20)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,2],[-2,0]]),20)


sol=f_prism(sec,path)
# sol1=prism(sec,path_offset(path,-.5))
# sol2=swp_prism_h(sol,sol1)

with open('trial.scad','w+') as f:
    f.write(f'''

{swp(sol)}

''')

t1=time.time()
t1-t0
```

Out[5]:

```
3.5346200466156006
```

f_prism(sec,path)

In [2]:
```
# example of function prism(sec,path) and function swp_prism_h(prism_big, prism_small)
t0=time.time()
# sec=corner_radius(pts1([[0,0,.2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
sec=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)
# sec=corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7],[-40,0
# sec=pts([[0,0],[10,0],[0,5],[-10,0]])
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,4.2],[-4.2,0]]),20)
path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,5.2],[-5.2,0]]),20)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,2],[-2,0]]),20)


sol=f_prism(sec,path)
# sol1=f_prism(sec,path_offset(path,-.5))
# sol2=f_swp_prism_h(sol,sol1)

with open('trial.scad','w+') as f:
    f.write(f'''

{swp(sol)}

''')

t1=time.time()
t1-t0
```

Out[2]:
```
2.6082491874694824
```

p_cir_t

In [56]:
```
# example of function p_cir_t(pnt,cir)
cir=c3t2(translate([20,10,0],circle(10)))
point=[3,5]
tangent_point=p_cir_t(point,cir)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
```

```
%p_line({cir},.1);
color("magenta")points({[point]},.5);
color("cyan")points({[tangent_point]},.5);
%p_line({[point,tangent_point]},.05);
    ''')
```

v_sec_extrude

In [57]:
```
# example of function v_sec_extrude(sec,path,o)

sec=corner_radius(pts1([[0,0,1],[10,0,1],[0,5,1],[-10,0,1]]),10)
path=helix(20,15,1,5)

sol=v_sec_extrude(sec,path,-2)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sol)}
    ''')
```

t_cir_tarc

In [58]:
```
# example of function t_cir_tarc(r1,r2,cp1,cp2,r,side=0,s=50)

r=17
arc1=t_cir_tarc(10,5,[0,0],[-15,10],r,0,20)

c1=circle(10)
c2=circle(5,[-15,10])
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

%p_line({c1},.05);
%p_line({c2},.05);
arc1={arc1};
color("blue") p_line3d(arc1,.1);
color("magenta")points({[arc1[0],arc1[-1]]},.2);

    ''')
```

In [59]:

```
# example of function t_cir_tarc

cir1=circle(20)
cir2=circle(10,[52.5*cos(d2r(30)),52.5*sin(d2r(30))])
cp1,cp2=[52.5*cos(d2r(30)),52.5*sin(d2r(30))],[0,0]

arc1=t_cir_tarc(10,20,cp1,cp2,45,0)
arc3=t_cir_tarc(10,20,cp1,cp2,18.75,1)
arc2=arc_long_2p(arc1[-1],arc3[0],20,-1)[1:-1]
arc4=arc_2p(arc3[-1],arc1[0],10,-1)[1:-1]


sec=arc1+arc2+arc3+arc4
sol=linear_extrude(sec,10)
sol1=translate([0,0,-.5],translate(c2t3(cp1),cylinder(r=5,h=11)))
sol2=translate([0,0,-.5],translate(c2t3(cp2),cylinder(r=10,h=11)))

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
//p_line3d({cir1},.1);
//p_line3d({cir2},.1);
//sec={sec};
//color("magenta")p_line3d(loop(sec,0,len(sec)*$t),.5);
difference(){{
{swp(sol)}
{swp(sol1)}
```

```
{swp(sol2)}


}}
''')

arc1[-1]
```

Out[59]: [-19.93067428455553, 1.6637976328138104]

tcct

In [60]:

```
# example of function tcct(r1,r2,cp1,cp2,cw=-1)
c1=circle(10)
c2=circle(5,[15,-8])

line= tcct(10,5,[0,0],[15,-8],cw=-1)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

%p_line({c1},.05);
%p_line({c2},.05);
color("blue") p_lineo({line},.05);



    ''')
```

arc_3p

In [61]:
```
# example of function arc_3p(p1,p2,p3,s=30)

p1,p2,p3=[3,0],[0,0],[0,3]
arc1=arc_3p(p1,p2,p3)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>


color("blue") p_lineo({arc1},.05);
points({[p1,p2,p3]},.2);
    ''')
```

cir_3p

In [62]:
```
# example of function cir_3p(p1,p2,p3,s=30)

p1,p2,p3=[3,0],[0,0],[0,3]
cir=cir_3p(p1,p2,p3,30)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>


color("blue") p_line({cir},.05);
points({[p1,p2,p3]},.2);
    ''')
```

cp_3p

In [63]:
```
# example of function cp_3p(p1,p2,p3)

p1,p2,p3=[3,0],[0,0],[0,3]
cir=cir_3p(p1,p2,p3,30)
center= cp_3p(p1,p2,p3)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>


color("blue") p_line({cir},.05);
points({[p1,p2,p3]},.2);
color("magenta")points({[center]},.2);
    ''')
```

pies1

In [7]:

```
# example of function pies1(sec,pnts)
# function points inside enclosed section
t0=time.time()
a=random.random(10000)*(20-(-5))+(-5)
b=random.random(10000)*(25-(-2))+(-2)
points=array([a,b]).transpose(1,0).tolist()
# sec=corner_radius(pts1([[2,1,.1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)
sec=corner_radius(pts1([[8,0],[11,10,10],[0,10,5],[-10,0,5],[-1,-6,0.3],[-1,6,5],[-10,0,5],[0

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>


color("blue") p_line({sec},.05);
points({points},.2);
color("magenta")points({pies1(sec,points)},.2);
    ''')
t1=time.time()
t1-t0
```

Out[7]:

```
0.22714662551879883
```

In [22]:

```
# example of pies1(sec,pnts)
t0=time.time()

a=random.random(10000)*(10-0)+0
b=random.random(10000)*(20-0)+0
c=array([a,b]).transpose(1,0).tolist()


sec=corner_radius(pts1([[1.5,8,.9],[2,0,.9],[0,-3,1.4],[3,0,1.4],[0,4,1.9],[-5,0,2.5],[0,6,2.
                [7,0,2.5],[0,-4,.9],[-2,0,.9],[0,3,1.4],[-3,0,1.4],[0,-4,1.9],
               [5,0,2.5],[0,-6,2.5],[-7,0,2.5]]),20)

pnts=pies1(sec,c)
pnts1=pies1(oset(sec,-.45),pnts)

with open('trial.scad','w+')as f:
    f.write(f'''
    include<dependencies.scad>
    //points({c},.1);
    color("magenta")points({pnts},.1);
    color("cyan")points({pnts1},.1);
    color("blue")p_line({sec},.05);
    color("green")p_line({oset(sec,-.45)},.05);

    ''')

t1=time.time()
t1-t0
```

Out[22]:

```
0.5103778839111328
```

swp_prism_h

In [8]:
```
# example of function swp_prism_h(prism_big,prism_small)

sec1=circle(10)
path=corner_radius(pts1([[2,0],[-2,0,2],[0,10,3],[-3,0]]),5)
sol=prism(sec1,path)
sol1=surf_offset(sol,-1)
sol2=swp_prism_h(sol,sol1)
```

```
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp_c(sol2)}


''')
```

In [23]:

```
# example of function prism(sec,path) and function swp_prism_h(prism_big, prism_small)
t0=time.time()
# sec=corner_radius(pts1([[0,0,.2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
# sec=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,5],[-7,5,5]]),20)
sec=corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7],[-40,0,7
# sec=pts([[0,0],[10,0],[0,5],[-10,0]])
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,4.2],[-4.2,0]]),20)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,5.2],[-5.2,0]]),20)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,2],[-2,0]]),20)

# sec=equidistant_pathc(sec,300)
sec1=oset(sec,.5)

sol=linear_extrude(sec,50)
sol1=linear_extrude(sec1,50)
sol2=swp_prism_h(sol1,sol)

with open('trial.scad','w+') as f:
    f.write(f'''

include<dependencies2.scad>
```

```
{swp_c(sol2)}

''')

t1=time.time()
t1-t0
```

Out[23]:
```
0.02878570556640625
```

In [24]:
```
sec=corner_radius(pts1([[0,0,1],[25,0,1],[0,15,1],[-25,0,1]]),10)
sec1=oset(sec,2)
sol=linear_extrude(sec,10)
sol1=linear_extrude(sec1,10)
sol2=swp_prism_h(sol1,sol)

with open('trial.scad','w+') as f:
    f.write(f'''

include<dependencies2.scad>
{swp_c(sol2)}

''')
```

In [25]:
```
sec=corner_radius(pts1([[0,0,1],[15,0,1],[0,10,1],[-15,0,1]]),10)
sec1=oset(sec,2)
sol=linear_extrude(sec,10)
sol1=linear_extrude(sec1,10)
sol2=swp_prism_h(sol1,sol)

with open('trial.scad','w+') as f:
    f.write(f'''

include<dependencies2.scad>
{swp_c(sol2)}

''')
```

surf_base

In [4]:
```
# example of function surf_base(surf,h)
t0=time.time()

sec2=corner_radius(pts1([[-25,0],[10,5,5],[10,-3,10],[10,5,5],[10,-8,7],[10,1]]),10)
path2=cytz(corner_radius(pts1([[-35,5,0],[10,8,20],[20,-5,10],[20,8,20],[10,-9,20],[10,1,0]])
surf2=surf_extrude(sec2,path2)
sol=surf_base(surf2,0)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
difference(){{
{swp(sol)}
//{swp(cut_plane([0,0,1],[15,10],20,10))}
}}
''')
t1=time.time()
total=t1-t0
total
```

Out[4]:
```
0.10061192512512207
```

helix

In [71]:
```
# example of function helix(radius=10,pitch=10, number_of_coils=1, step_angle=1)

path=helix(10,5,10,5)
sec=circle(1)
sol=path_extrude_open(sec,path)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
//p_line3d({path},1,$fn=20);
{swp(sol)}
    ''')
```

offset_points_cw

In [72]:
```
# example of function offset_points_cw(sec,r)

sec=corner_radius(pts1([[0,0,.2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
# sec=corner_radius(pts1([[0,0,.1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)
# sec=corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7],[-40,0

# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,4.2],[-4.2,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,5.3],[-5.3,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,2],[-2,0]]),20)


offsetPoints=offset_points_cw(sec,-2)
```

```
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.05);
color("magenta")points({offsetPoints},.2);

''')
```

offset_points_ccw

In [68]:
```
# example of function offset_points_ccw(sec,r)

sec=corner_radius(pts1([[0,0,.2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
# sec=corner_radius(pts1([[0,0,.1],[7,5,2],[5,7,3],[-5,7,5],[-7,5,5]]),20)
```

```
# sec=corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7],[-40,0

# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,4.2],[-4.2,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,5.3],[-5.3,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,2],[-2,0]]),20)


offsetPoints=offset_points_ccw(sec,2)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.05);
color("magenta")points({offsetPoints},.2);

''')
```

cpo

In [73]:
```
# example of function cpo(prism)

sec=corner_radius(pts1([[0,0,.2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),10)
# sec=corner_radius(pts1([[0,0,.1],[7,5,2],[5,7,3],[-5,7,5],[-7,5,5]]),20)
# sec=corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7],[-40,0
```

```
path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,4.2],[-4.2,0]]),10)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,5.3],[-5.3,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,2],[-2,0]]),20)

sp1=translate([0,50,0],sphere(10,s=20))
sp2=translate([30,0,0],cpo(sp1))


sol=prism(sec,path)
sol1=translate([20,0,0],cpo(sol))

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")for(p={sol})p_line3dc(p,.1,1);
color("magenta")for(p={sol1})p_line3d(p,.1,1);

color("blue")for(p={sp1})p_line3dc(p,.1,1);
color("magenta")for(p={sp2})p_line3d(p,.1,1);

''')
```

fillet_3p_3d

In [74]:
```
# example of function fillet_3p_3d(p0,p1,p2,r,s)
```

```
p1,p2,p3=[[3,0,0],[0,0,0],[0,3,3]]
fillet=fillet_3p_3d(p1,p2,p3,3,10)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")p_line3dc({fillet},.05);
color("cyan")points({[p1,p2,p3]},.2);

''')
```

fillet_3p_3d_cp

In [75]:
```
# example of function fillet_3p_3d_cp(p0,p1,p2,r)

p1,p2,p3=[[3,0,0],[0,0,0],[0,3,3]]
fillet=fillet_3p_3d(p1,p2,p3,3,10)
centerPoint=fillet_3p_3d_cp(p1,p2,p3,3)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")p_line3dc({fillet},.05);
color("magenta")points({[centerPoint]},.2);


''')
```

arc_3p_3d

In [76]:
```
# example of function arc_3p_3d(points,s)

p1,p2,p3=[[3,0,0],[0,1,0],[5,3,2]]
arc1=arc_3p_3d([p1,p2,p3],30)



with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("magenta")p_line3d({arc1},.05);
color("blue")points({[p1,p2,p3]},.2);


''')
```

cir_3p_3d

cp_cir_3d

In [77]:

```
# example of function cir_3p_3d(points,s)

p1,p2,p3=[[3,0,0],[0,0,0],[0,3,2]]
cir=cir_3p_3d([p1,p2,p3],50)

cp1=cp_cir_3d(cir)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("magenta")p_line3dc({cir},.05);
color("blue")points({[p1,p2,p3]},.2);
color("cyan")points({[cp1]},.2);

''')
```

linear_extrude

In [9]:
```
# example of function linear_extrude(sec,h=1,a=0,steps=1)

sec=corner_radius(pts1([[0,0,1],[10,0,1],[0,5,1],[-10,0,1]]),5)
sol=linear_extrude(sec,50,360,50)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

//color("magenta") for(p={sol})p_line3dc(p,.05);
{swp(sol)}

''')
```

rsz3d

In [79]:
```
# example of function rsz3d(prism,rsz)

sec=corner_radius(pts1([[0,0,1],[10,0,1],[0,5,1],[-10,0,1]]),5)
sol=translate([-5,0,0],linear_extrude(sec,10))
sol1=rsz3d(sol,[5,6,7])

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%{swp(sol)}
```

```
{swp(sol1)}

''')
```

rsz3dc

In [80]:
```
# example of function rsz3dc(prism,rsz)

sec=corner_radius(pts1([[0,0,1],[10,0,1],[0,5,1],[-10,0,1]]),5)
sol=translate([-5,0,0],linear_extrude(sec,10))
sol1=rsz3dc(sol,[5,2.5,5])

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%{swp(sol)}
{swp(sol1)}

''')
```

bb

In [81]:
```
# example of function bb(prism)

sec=corner_radius(pts1([[0,0,1],[10,0,1],[0,5,1],[-10,0,1]]),5)
sol=translate([-5,0,0],linear_extrude(sec,10))
dim=bb(sol)
sol1=rsz3dc(sol,array(dim)-[2,2,2])

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%{swp(sol)}
{swp(sol1)}

''')
```

cube

In [82]:

```
# example of function cube(s,center=False)

sol=cube([5,4,7],False)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sol)}

''')
```

sphere

In [83]:
```
# example of function sphere(r=0,c=[0,0,0],s=50)


sol=sphere(10,[15,15,10],30)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
difference(){{
{swp(sol)}
//cube(10);
}}
''')
```

rsz2d

In [84]:
```
# example of function rsz2d(sec,rsz)

sec=corner_radius([[0,0,.5],[10,0,2],[7,15,1]],5)
sec1=rsz2d(sec,[4,3])
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.1);
color("magenta")p_line({sec1},.1);


''')
```

rsz2dc

In [85]:
```
# example of function rsz2dc(sec,rsz)

sec=corner_radius([[0,0,.5],[10,0,2],[7,15,1]],5)
sec1=rsz2dc(sec,[4,3])
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.1);
color("magenta")p_line({sec1},.1);


''')
```

cs1

In [86]:
```
# example of function cs1(sec,d) cs1 meaning cleaning section. This function is used in offse

sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),10)
# sec=corner_radius(pts1([[0,0,.1],[7,5,2],[5,7,3],[-5,7,5],[-7,5,5]]),20)
# sec=corner_radius(pts1([[-15,0,2.49],[0,15,3],[30,0,3],[0,-15,2.49],[5,0,2.49],[0,20,7],[-4

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.05);
color("magenta",.2)for(p={cs1(sec,-2)})p_line(p,.05);


''')
```

convert_secv1

In [35]:
```
# example of function convert_secv1(sec,d)

sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
sec=sec=corner_radius(pts1([[0,0,.1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)
sec=corner_radius(pts1([[-15,0,2.49],[0,15,3],[30,0,3],[0,-15,2.49],[5,0,2.49],[0,20,7],[-40,
# sec=circle(10)
# sec=pts([[0,0],[10,0],[0,10],[-10,0]])

sec1=convert_secv1(sec)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.3);

color("magenta")p_line({sec1},.3);

''')
```

convert_secv

In [33]:
```
# example of function convert_secv(sec)

sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),40)
# sec=sec=corner_radius(pts1([[0,0,.1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)
# sec=corner_radius(pts1([[-15,0,2.49],[0,15,3],[30,0,3],[0,-15,2.49],[5,0,2.49],[0,20,7],[-4
# sec=circle(10)
# sec=pts([[0,0],[10,0],[0,10],[-10,0]])
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,4.2],[-4.2,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2.2],[0,7,5.3],[-5.3,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,2],[-2,0]]),20)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

p_line({sec},.3);
color("blue")p_line({convert_secv(sec)},.3);

''')
```

convert_secv2

In [34]:
```
# example of function convert_secv2(sec,d)

sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),40)
# sec=sec=corner_radius(pts1([[0,0,.1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)
# sec=corner_radius(pts1([[-15,0,2.49],[0,15,3],[30,0,3],[0,-15,2.49],[5,0,2.49],[0,20,7],[-4
# sec=circle(10)
# sec=pts([[0,0],[10,0],[0,10],[-10,0]])
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,4.2],[-4.2,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2.2],[0,7,5.3],[-5.3,0]]),40)
# path=corner_radius(pts1([[2,0],[-2,0,2],[0,7,2],[-2,0]]),20)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

p_line({sec},.3);
color("blue")p_line({convert_secv2(sec,5)},.3);

''')
```

c2ro

In [14]:

```
# example of function c2ro(sol,s), 'c2ro' stands for circular to rectangular orientation

cyl=linear_extrude(circle(5,s=30),10)

cyl1=translate([15,0,0],c2ro(cyl,1))

cyl2=translate([30,0,0],cpo(c2ro(cyl,5)))

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>


color("blue")for(p={cyl})p_line3dc(p,.05);
color("blue")for(p={cyl1})p_line3dc(p,.05);
color("blue")for(p={cyl2})p_line3d(p,.05);
swp({cyl});

    ''')
# for i in range(14):
#     with open('trial.scad','a')as f:
#         f.write(f'''
#     {swp(cyl1[i:i+1])}

#     {swp(cyl)}

#     ''')
cyl1[0]
```

Out[14]:

```
[[20.0, 0.0, 0.0],
 [20.0, 0.0, 10.0],
 [19.883102778550434, -1.0748522010551218, 10.0],
 [19.883102778550434, -1.0748522010551218, 0.0]]
```

In [11]:

```
# example of function c2ro(sol,s)

sp=sphere(5,s=21)

sp1=translate([15,0,0],c2ro(sp,3))

sp2=translate([30,0,0],cpo(c2ro(sp,3)))

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>


color("blue")for(p={sp})p_line3dc(p,.1);
color("blue")for(p={sp1})p_line3dc(p,.1);
color("blue")for(p={sp2})p_line3d(p,.1);


    ''')
```

In [15]:

```
# application of function c2ro(sol, s) for creating fillet between 2 cylinders

sec=circle(5,s=50)
path=corner_radius(pts1([[-1,2],[1,0,1],[0,10,1],[-1,0]]),10)

sol1=linear_extrude(circle(10,s=100),14)

sol2=translate([10,0,0],c2ro(f_prism(sec,path),10))

sol3=translate([10,0,0],f_prism(sec,path))

sol5=ip_fillet(sol1,flip(sol2),1,-1)
# sol5=cpo(sol5)[:-1]

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
%{swp(sol3)}
%{swp(sol1)}
{swp(sol5)}


//color("blue")for(p={cpo(sol2)})p_line3d(p,.02);
//color("blue")for(p={sol5})p_line3dc(p,.02);
    ''')
```

sl_int

In [14]:

```
# example of function sl_int(sec,line)

sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
sec=translate([0,0,10],q_rot(['y30','x30'],sec))
line=[[5,0,0],[8,8,10]]
ip_1=sl_int(sec,line)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line3dc({sec},.1);
color("magenta")p_line3d({line},.1);
color("magenta")points({ip_1},.3);


    ''')
```

In [91]:

```
sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
sec=translate([0,0,10],q_rot(['y30','x30'],sec))
sol=cpo(linear_extrude(circle(2,[5,9],s=50),20))
# lines=array(sol).reshape(-1,2,3)
ip_1=[sl_int(sec,line) for line in sol if sl_int(sec,line)!=[]]
ip_1=concatenate(ip_1).tolist()
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
polyhedron({sec},{[arange(len(sec)).tolist()]});
color("blue")p_line3dc({sec},.05);
color("magenta")points({ip_1},.1);
%{swp(cpo(sol))}

    ''')
```

axis_rot

In [92]:
```
# example of function axis_rot(axis,solid,angle)
vector=[2,3,5]
# sec=translate([-5,5,0],circle(5))
sec=path_extrude_closed(circle(.05),c2t3(circle(5)))
sec1=[path_extrude_closed(circle(.05),axis_rot(vector,circle(5),i)) for i in arange(0,360,20)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>


for(p={sec1})swp(p);
//original section
color("blue"){swp(sec)}
// axis of rotation
color("magenta")p_line3d({[[0,0,0],vector]},.1);

    ''')
```

path_extrude_closed

In [97]:
```
sec=circle(1,s=20)
path=c2t3(circle(10,s=20))
sol1=path_extrude_closed(sec,path)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
$fn=20;
for(p={sol1})p_line3dc(p,.05);
for(p={cpo(sol1)})p_line3dc(p,.05);

    ''')
```

cam-profile

In [15]:

```
# example of cam profile

path1=m_points_o(corner_radius(pts1([[0,15],[12,0,5],[10,-5,.5],[22,0]]),5),.5)
path2=array(c2t3(arc(10,0,362,s=len(path1)-1)))

path_h=array([[0,0,y] for (x,y) in path1])
path3=(path2+path_h).tolist()
sketch1=[[-1.5,0],[1.5,0]]
surf1=surf_extrude(sketch1,path3)
surf2=c2t3(c3t2(surf1))
s1,s2=array(surf1),array(surf2)

a,b=s2.transpose(1,0,2)
c,d=s1.transpose(1,0,2)
sol=array([a,c,d,b]).transpose(1,0,2).tolist()

arc1=translate([0,0,0],arc(10,10,200,s=50))
arc2=translate([0,0,50],arc1)
sol1=[arc1,arc2]

ip_1=ip_surf(sol,sol1)
ip_1=min_d_points(ip_1,.1)

sec=circle(.75)
sol2=path_extrude_open(sec,ip_1)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
//points({path1},.2);
//points({path3},.2);
//color("magenta")p_line3d({ip_1},.2);
difference(){{
{swp(sol)}
{swp(sol2)}
```

```
}}
''')
```

2W-wheel

In [26]:

```
# 2w wheel completely designed in openscad, it takes 160 sec to compute

t1=time.time()

p0=[[-3,-5-41/2,3],[15,-5,2],[0,7,5],[-12,3,2],[-1,8,.5],[1,1,1.5],
    [-.25,2,1.5],[-8,2,3],[0,15,3],[8,2,1.5],[0.25,2,1.5],
   [-1,1,1],[1,8,2],[12,3,5],[0,7,2],[-15,-5,3],[-2,-13,2],
   [-8,-2,3],[-2,-10.5,3],[2,-10.5,3],[8,-2,3]]
sec=corner_radius(pts1(p0),10)
path=c2t3(circle(12*25.4/2,s=100))
sol=path_extrude_closed(sec,path)

p1=[[0,-15,.5],[6,0,.3],[0,-16,.1],[1,-1,.1],[4,0,.2],[2,10,4],[35,0,10],
    [5,22,5],[-5,22,10],[-35,0,4],[-2,10,.2],[-4,0,.1],[-1,-1,.1],[0,-16,.3],
    [-6,0,.5]]
sec1=corner_radius(pts1(p1),10)
sec2=oset(sec1,-4)
path1=c2t3(circle(10,s=72))
sol1=path_extrude_closed(sec1,path1)
sol2=path_extrude_closed(sec2,path1)

sec3=circle(7)
path2=corner_radius(pts1([[2,0],[-2,25+7]]),10)
```

```
# Disc mounting post top
sol3=translate([51,0,18-7],prism(sec3,path2))


arc1=flip(c2t3(arc(30,13,60,s=10)))
arc2=c2t3(arc(45,18,55,s=10))

p2=(array(arc2[0])+[0,0,3]).tolist()
p3=arc2[1:-1]
p4=(array(arc2[-1])+[0,0,3]).tolist()
p5=(array(arc1[0])+[0,0,3]).tolist()
p6=arc1[1:-1]
p7=(array(arc1[-1])+[0,0,3]).tolist()

pl=[p2]+p3+[p4]+[p5]+p6+[p7]
sec4=corner_radius(pl,10)
# sand extraction opening top
sol4=linear_extrude(sec4,50)

# Disc mounting post bottom
sol5=q_rot(['z45'],translate([51,0,-18+7],q_rot(['y180'],f_prism(sec3,path2))))

# sand extraction opening bottom
sol6=q_rot(['z-30'],translate([0,0,-50],sol4))

sec5=corner_radius(pts1([[-20,-7.5,2.49],[5,0,2.49],[0,10,3],[15,2,70],[15,-2,3],[0,-10,2.49]
             [5,0,2.49],[1,10,1],[-1,5,7],[-20,3,90],[-20,-3,7],[-1,-5,1]]),10)


sol7=translate([0,50,-2.5],q_rot(['x90','z200'],[c2t3(sec5),translate([0,0,93],scl2d_c(sec5,.

fillet1=ip_fillet_surf(sol1,sol3,4,-4)
fillet2=ip_fillet_surf(sol1,sol5,4,-4)

fillet3=ip_fillet(sol1,sol7,6,-6)
fillet4=ip_fillet(sol,flip(sol7),5,5)

end_round_1=end_cap(q_rot(['x.0001'],sol3),2)[1]
end_round_2=end_cap(q_rot(['x.0001'],sol5),2)[1]


with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

{swp_c(sol)}
difference()
{{
    difference()
    {{
        union()
        {{
            {swp_c(sol1)}
            for(i=[0:360/5:359])
            rotate([0,0,i])
            {{
            difference()
                {{
                    {swp(sol3)}
                    {swp_c(end_round_1)}
                }}
            difference()
                {{
                    {swp(sol5)}
                    {swp_c(end_round_2)}
                }}
                {swp(sol7)}

            }}
```

```
        }}

        {swp_c(sol2)}
    }}

    for(i=[0:360/5:359])
    rotate([0,0,i])
    {{
        {swp(sol4)}
        {swp(sol6)}
    }}

}}

for(i=[0:360/5:359])
rotate([0,0,i])
{{
{swp_c(fillet1)}
{swp_c(fillet2)}
{swp_c(fillet3)}
{swp_c(fillet4)}


}}

''')

t2=time.time()
t2-t1
```

Out[26]:

```
9.496249437332153
```

drill-bit

In [7]:

```
# drill bit

sec=circle(7.5,s=101)
path=pts([[-7.5*cos(360/200*pi/180),0],[7.5,5],[0,70]])
```

```
sol=prism(sec,path)
hx1=helix(7.5,20,2,5)
hx2=q_rot(['z180'],hx1)
with open('trial.scad','w+')as f:
    f.write(f'''
    include<dependencies2.scad>
//    render(){{

difference(){{
   color("orange"){swp(sol)}
   color("cyan")p_line3d({hx1},2.5,$fn=70);
   color("cyan")p_line3d({hx2},2.5,$fn=70);

   }}
//   }}
    ''')
```

bottle-with-cut-design

In [17]:
```
# bottle with cut design
i_t=time.time()
sec=circle(10,s=50)
path=corner_radius(pts1([[-3,0,0],[3,0,3],[3,5,7],[-5,20,100],[8,30,20],[-11,10,5],[0,10,0]])
path=equidistant_path(path,100)
sol=prism(sec,path)

sec1=corner_radius(pts1([[-5,10,3],[10,0,3],[0,20,30],[-3,20,30],[0,10,1.9],[-4,0,1.9],[0,-10
sec1=equidistant_pathc(sec1,200)
path1=corner_radius(pts1([[1,0],[-1,0,1],[-1,1,1],[-.5,0]]),10)
```

```
path1=equidistant_path(path1,20)
surf_1=f_prism(sec1,path1)

l1=equidistant_path([[0,15,1],[0,55,1]],200)
l1=sort_points(surf_1[-1],l1)
surf_1=surf_1[:-1]+slice_sol([surf_1[-1],l1],5)
sol3=translate([0,0,-1.5],surf_1)
sol2=flip(sol3)+surf_1#+[flip(sol3)[0]]
path=q_rot(['y90'],path)
sol2=[wrap_around(p,path) for p in sol2]
sol2=translate([0,6.01,0],q_rot(['z90'],sol2))
path2=q_rot(['y90'],circle(10,s=200))
sol2=[wrap_around(p,path2) for p in sol2]

sol2=q_rot(['y90'],sol2)

path=corner_radius(pts1([[-3,0,0],[3,0,3],[3,5,7],[-5,20,100],[8,30,20],[-11,10,5],[0,10,0]])
path=equidistant_path(path,100)
path1=path_offset(path,-.5)
sol3=prism(sec,path1)
surf_2=surf_offset(surf_1,.5)
surf_3=translate([0,0,-1.5],surf_2)
sol4=flip(surf_3)+surf_2
path=q_rot(['y90'],path)
sol4=[wrap_around(p,path) for p in sol4]
sol4=translate([0,6.01,0],q_rot(['z90'],sol4))
path2=q_rot(['y90'],circle(10,s=200))
sol4=[wrap_around(p,path2) for p in sol4]
sol4=q_rot(['y90'],sol4)

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
difference(){{
difference(){{
difference(){{
{swp(sol)}
for(i=[0,90,180,270])
rotate([0,0,i])
{swp(sol2)}
}}

   difference(){{
  {swp(sol3)}
  for(i=[0,90,180,270])
rotate([0,0,i])
  {swp(sol4)}
  }}
}}

{swp(cut_plane([0,-1,0],[300,300],300,theta=[0,0,55]))}
}}
    ''')

f_t=time.time()
f_t-i_t
```

Out[17]:

```
4.199722766876221
```

example-of-rounding

In [6]:
```
# m37 rounded
i_t=time.time()
sec=[[i,3*sin(i*18*pi/180)] for i in arange(-20,20,.5)]

path=[[i,0,20+3*sin(i*12*pi/180)] for i in arange(-30,30,.5)]

surf=surf_extrude(sec,path)
surf1=surf_base(surf,0)
sec1=corner_radius(pts1([[0,0,2],[20,0,2],[0,20,2]]),40)
sec1=equidistant_pathc(sec1,200)
sol1=linear_extrude(sec1,40)
ip1=remove_extra_points(array(ip_surf(surf,sol1)).round(5))
fillet1=i_line_fillet(surf1,sol1,ip1,-1,1,s=10)
```

```
sol2=flip(solid_from_fillet_closed(fillet1,3))
with open('trial.scad','w+')as f:
    f.write(f'''
    include<dependencies2.scad>

difference(){{
    intersection(){{
    {swp(surf_base(surf,0))}
    {swp(sol1)}
   }}
{swp_c(sol2)}
}}

    ''')
f_t=time.time()
f_t-i_t
```

```
C:\openscad\openscad-main\openscad1.py:4681: RuntimeWarning: divide by zero encountered in di
vide
  t=einsum('kl,ijkl->ijk',cross(p01,p02),la[:,:,None]-p0)/(einsum('ijl,kl->ijk',(-lab),cross
(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4683: RuntimeWarning: divide by zero encountered in di
vide
  v=einsum('ijkl,ijkl->ijk',cross((-lab)[:,:,None,:],p01[None,None,:,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4684: RuntimeWarning: invalid value encountered in add
  condition=(t>=0)&(t<=1)&(u>=0)&(u<=1)&(v>=0)&(v<=1)&(u+v<1)
C:\openscad\openscad-main\openscad1.py:4686: RuntimeWarning: invalid value encountered in mul
tiply
  a=(la[:,None,:,None,:]+lab[:,None,:,None,:]*t[:,None,:,:,None])
```

Out[6]:

```
5.144853115081787
```

m39

In [27]:

```
# m39
i_t=time.time()
p0=i_p2d(pts([[-45,0],[0,1]]),cir_theta_line(10,[-35,0],16.5,1))
p1=i_p2d(cir_theta_line(10,[-35,0],16.5,1),cir_theta_line(10,[35,0],-16.5,1))
p2=i_p2d(pts([[45,0],[0,1]]),cir_theta_line(10,[35,0],-16.5,1))
p3=[45,35]
p4=i_p2d([p3,p_cir_t(p3,circle(10,[0,44.06]))],[cir_p_t(circle(10,[0,44.06]),[-45,35]),[-45,3
p5=[-45,35]
p_l=array(c2t3([p0,p1,p2,p3,p4,p5]))
p_l=p_l+array([[0,0,i]  for i in [10,32.5,10,10,10,10]])

sec1=corner_radius(p_l,20)

p0,p1,p2,p3,p4,p5=oset([p0,p1,p2,p3,p4,p5],-2.5)

c1,c2,c3=[circle(7.5,i)  for i in [[-35,0],[35,0],[0,44.06]]]
a1=flip(fillet_l_cir([p0,p1],c1,2.5,10)[1])
a2=fillet_intersection_lines([p0,p1],[p2,p1],35,20)
a3=fillet_l_cir([p1,p2],c2,2.5,10)[0]
a4=flip(fillet_l_cir([p2,p3],c2,2.5,10)[1])
a3_1=arc_2p(a3[-1],a4[0],7.5,1,20)
a5=fillet_intersection_lines([p2,p3],[p4,p3],7.5,10)
a6=fillet_l_cir([p3,p4],c3,2.5,10)[0]
a7=flip(fillet_l_cir([p4,p5],c3,2.5,10)[1])
```

```
a6_1=arc_long_2p(a6[-1],a7[0],7.5,1,40)
a8=fillet_intersection_lines([p4,p5],[p0,p5],7.5,10)
a9=fillet_l_cir([p5,p0],c1,2.5,10)[0]
a10=arc_2p(a9[-1],a1[0],7.5,1,20)
sec2=a1+a2+a3+a3_1+a4+a5+a6+a6_1+a7+a8+a9+a10
sec2=remove_extra_points(array(sec2).round(4))

c4,c5,c6=[circle(5,i)  for i in [[-35,0],[35,0],[0,44.06]]]

path1=corner_radius(pts1([[-1.25,0],[1.25,0,1.25],[0,10,1.25],[-1.25,0]]),10)
sol1=f_prism(sec1,path1)

path2=corner_radius(pts1([[-1.25,1.25],[1.25,0,1.25],[0,10-1.25,1.25],[1.25,0],[0,.2]]),10)
sol2=f_prism(sec2,path2)

path3=corner_radius(pts1([[0.5,-.2],[0,0.2],[-.5,.5],[0,9],[.5,.5],[0,.2]]),5)
sol3=[f_prism(s,path3) for s in [c4,c5,c6]]
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
  difference(){{
  {swp(sol1)}
 {swp(sol2)}
  for(p={sol3}) swp(p);
    }}

    ''')
f_t=time.time()
f_t-i_t
```

Out[27]: 0.8033447265625

4W-wheel

In [28]:

```
# 4W
i_t=time.time()
```

```
# spoke1
sec1=corner_radius([[300,0,7], [0,0,10] , [300*cos(-30*pi/180),300*sin(-30*pi/180),7]]+c2t3(a
sec4=corner_radius(pts1([[3,0,0],[0,3,1.49],[-3,0,1.49],[0,-3,0]]),10)
sec=corner_radius(pts1([[-100,0],[100,30,500],[100,-30]]),20)
path=translate([0,0,217],q_rot(["y16","z15"],cytz(corner_radius(pts1([[0,0],[130,30,1000],[26
surf=surf_extrude(sec,path)
sec5=corner_radius([[300*cos(30*pi/180),300*sin(30*pi/180),7],[0,0,10],[300,0,7]]+c2t3(arc(30
sol4=linear_extrude(sec5,300)
sec6=corner_radius([[300*cos(30*pi/180),300*sin(30*pi/180),10],[0,0,30],[300,0,10]]+c2t3(arc(
sol5=translate([50*cos(15*pi/180),50*sin(15*pi/180),0],linear_extrude(m_points(sec6,10),300))
ip2=ip_surf(surf,sol5)
ip2= remove_extra_points(array(ip2).round(4))
bead2=path_extrude_closed(sec4,ip2)
cyl1=translate([110*cos(15*pi/180),110*sin(15*pi/180)],cylinder(r=15,h=300,s=40))
ip3=ip_surf(surf,cyl1)
ip3=remove_extra_points(array(ip3).round(4))
bead3=path_extrude_closed(sec4,ip3)
sec9=circle(245,s=100)
path9=corner_radius(pts1([[2,0],[-2,0,2],[0,5,5],[-13,20,5],[0,64,5],[-12,20,5],[0,78,5],[12,
sol7=f_prism(sec9,path9)
sec12=corner_radius([[50,0,4],[0,0,10],[50*cos(-30*pi/180),50*sin(-30*pi/180),4]]+c2t3(arc(50
sol12=linear_extrude(sec12,300)
sol14=q_rot(["z30"],sol12)
sol15=ip_fillet_surf(surf,sol14,3,-3)
sol16=linear_extrude(m_points(oset(sec1,-2.5),10),300)
sol18=q_rot(["z30"],sol16)
sol19=ip_fillet_surf(surf,sol18,3,3)
surf3=translate([0,0,-5],surf)
sol27=ip_fillet_surf(surf3,flip(sol18),3,3)
sol28=ip_fillet(surf3,flip(sol14),3,-3)




# spoke2
i_t=time.time()
sec10=corner_radius(pts1([[-100,0],[100,30,500],[100,-30]]),20)
path10=translate([0,0,190],q_rot(["y-4","z-15"],cytz(corner_radius(pts1([[0,0],[130,30,1000],
sec1=corner_radius([[300,0,7], [0,0,10] , [300*cos(-30*pi/180),300*sin(-30*pi/180),7]]+c2t3(a
sol1=linear_extrude(sec1,300)

sec9=circle(245,s=100)
path9=corner_radius(pts1([[2,0],[-2,0,2],[0,5,5],[-13,20,5],[0,64,5],[-12,20,5],[0,78,5],[12,
sol7=f_prism(sec9,path9)

surf1=surf_extrude(sec10,path10)
surf1t=surf_extrudef(surf1,-5)
# fillet_surf1t=ip_fillet(sol7,flip(surf1t),3,3)

sec2=corner_radius([[300,0,1], [0,0,15] , [300*cos(-30*pi/180),300*sin(-30*pi/180),1]]+c2t3(a
sol2=translate([50*cos(-15*pi/180),50*sin(-15*pi/180),0],linear_extrude(sec2,300))
sec3=corner_radius([[300,0,1], [0,0,15] , [300*cos(-30*pi/180),300*sin(-30*pi/180),1]]+c2t3(a
sol3=translate([50*cos(-15*pi/180),50*sin(-15*pi/180),0],linear_extrude(m_points(sec3,10),300
# sec4=corner_radius(pts1([[3,0,0],[0,3,1.49],[-3,0,1.49],[0,-3,0]]),10)
sec4=corner_radius(pts1([[3,-5,1.49],[0,8,1.49],[-3,0,1.49],[0,-8,1.49]]),10)
ip1=ip_surf(surf1,sol3)
bead1=path_extrude_open(sec4,ip1)
b1_fillet_1=ip_fillet(sol7,bead1[28:33],3,3)
b1_fillet_2=ip_fillet(sol7,flip(bead1[-50:-45]),3,-3)

sec12=corner_radius([[50,0,4],[0,0,10],[50*cos(-30*pi/180),50*sin(-30*pi/180),4]]+c2t3(arc(50
sol12=linear_extrude(sec12,300)

sol13=ip_fillet_surf(surf1,sol12,3,-3)
sol16=linear_extrude(m_points(oset(sec1,-2.5),10),300)

sol17=ip_fillet_surf(surf1,sol16,3,3)
surf2=translate([0,0,-5],surf1)
```

```
sol25=ip_fillet_surf(surf2,flip(sol16),3,3)
sol26=ip_fillet_surf(surf2,flip(sol12),3,-3)
sol31=cpo(ip_fillet_surf(surf2,sol3,1.5,-1.5))[:-1]



# spoke3

sec8=corner_radius(pts1([[-2.5,0,2.49],[5,0,2.49],[0,70,2.49],[-5,0,2.49]]),20)
sol6=translate([22,0,178],q_rot(["x90","z90"],linear_extrude(m_points(sec8,.25),300)))

sec9=circle(245,s=100)
path9=corner_radius(pts1([[2,0],[-2,0,2],[0,5,5],[-13,20,5],[0,64,5],[-12,20,5],[0,78,5],[12,
sol7=f_prism(sec9,path9)

sol8=ip_fillet(sol7,flip(sol6),3,-3)

sec11=circle(45,s=100)
path11=corner_radius(pts1([[0,175],[5,0,5],[0,65,5],[-25,15,5],[-24.5,0]]),15)
sol9=f_prism(sec11,path11)
sol10=ip_fillet(sol9,sol6,3,-3)



# Hub

sec11=circle(45,s=100)
path11=corner_radius(pts1([[0,175],[5,0,5],[0,65,5],[-25,15,5],[-24.5,0]]),15)
sol9=f_prism(sec11,path11)



#  Rim

sec9=circle(245,s=100)
path9=corner_radius(pts1([[2,0],[-2,0,2],[0,5,5],[-13,20,5],[0,64,5],[-12,20,5],[0,78,5],[12,
sol7=f_prism(sec9,path9)


sec13=circle(250,s=100)
path12=corner_radius(pts1([[-2,0],[2,0,2],[0,5,5],[-13,20,5],[0,64,5],[-12,20,5],[0,78,5],[12
sol23=f_prism(sec13,path12)


with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>


    // spoke 1

    for(i=[0:60:300])rotate([0,0,i])
    difference(){{
    difference(){{
    intersection(){{
    {swp(surf_extrudef(surf_extrude(sec,path),-5))}
    {swp(sol4)}
    {swp(sol7)}
    }}
    {swp(sol5)}
    {swp(cyl1)}

    }}
    {swp(cpo(ip_fillet_surf(surf3,cyl1,2,-2))[:-1])}
    {swp(cpo(ip_fillet_surf(surf3,sol5,2,-2))[:-1])}

    }}

        for(i=[0:60:360-60])
```

```
    rotate([0,0,i])
intersection(){{
    {swp_c(flip(sol19))}
    {swp(sol7)}
  }}

for(i=[0:60:360-60])
rotate([0,0,i])
{swp_c(sol15)}

for(i=[0:60:360-60])
rotate([0,0,i])
intersection(){{
{swp_c(sol27)}
{swp(sol7)}
  }}

for(i=[0:60:360-60])
rotate([0,0,i])
{swp_c(sol28)}

for(i=[0:60:300])rotate([0,0,i])
intersection(){{
{swp_c(bead2)}
{swp(sol7)}
    }}

for(i=[0:60:300])rotate([0,0,i]){{
{swp_c(bead3)}
}}

// spoke 2


{{for(i=[0:60:300])rotate([0,0,i])
difference(){{
intersection(){{
{swp(surf1t)}
{swp(sol1)}
{swp(sol7)}
}}
{swp(sol2)}
{swp(flip(sol31))}
}}
}}



for(i=[0:60:360-60])
rotate([0,0,i]){{
intersection(){{
{swp(bead1)}
{swp(sol7)}
}}


{swp_c(b1_fillet_1)}
{swp_c(b1_fillet_2)}
}}


for(i=[0:60:360-60])
rotate([0,0,i]){{
intersection(){{
{swp_c(sol25)}
{swp(sol7)}
}}
{swp_c(sol26)}
}}
```

```
    for(i=[0:60:360-60])
    rotate([0,0,i])
    {swp_c(sol13)}

    for(i=[0:60:360-60])
    rotate([0,0,i])
    intersection(){{
    {swp_c(flip(sol17))}
    {swp(sol7)}
    }}


    // spoke 3
    for(i=[0:30:360-30])
    rotate([0,0,i])
    intersection(){{
    {swp(sol6)}
    {swp(sol7)}
    }}

    for(i=[0:30:360-30])
    rotate([0,0,i]){{
    {swp_c(sol8)}
    {swp_c(sol10)}
    }}


    // hub
    difference(){{
    {swp(sol9)}
    {swp(cylinder(r=20,h=300,s=72))}
    }}

    // rim
    {swp_c(swp_prism_h(sol23,sol7))}


    ''')

f_t=time.time()
f_t-i_t
```

Out[28]: 12.913909912109375

cylinder-with-rectangular-pocket

In [116…

```
# cylinder with rectangular pocket
t=2 #thickness
n=100 # number of segments in the circle
s=[15,25] #size of the pocket
cir=circle(20,s=n)
path=corner_radius(pts1([[t/2,0,t/2],[0,80,t/2-.001],[-t,0,t/2-.001],[0,-80,t/2]]),20)
sol1=prism(cir,path)
sol1=sol1+[sol1[0]]

sec1=corner_radius(pts1([[-s[1]/2,-s[0]/2,t],[s[1],0,t],[0,s[0],t],[-s[1],0,t]]),10)
sol2=translate([0,0,40],q_rot(["y90"],linear_extrude(m_points(sec1,.51),40)))

fillet1=cpo(ip_fillet(sol1,flip(sol2),t/2,-t/2))[:-1]
fillet2=cpo(ip_fillet(flip(sol1),sol2,t/2,-t/2))[:-1]
sol3=flip([translate([5,0,0],fillet1[0])]+fillet1+flip(fillet2)+[translate([-5,0,0],fillet1[0

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

difference(){{
{swp_c(sol1)}
{swp(sol3)}
```

```
}}


''')
```

```
C:\openscad\openscad-main\openscad1.py:4685: RuntimeWarning: divide by zero encountered in di
vide
  t=einsum('kl,ijkl->ijk',cross(p01,p02),la[:,:,None]-p0)/(einsum('ijl,kl->ijk',(-lab),cross
(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4685: RuntimeWarning: invalid value encountered in div
ide
  t=einsum('kl,ijkl->ijk',cross(p01,p02),la[:,:,None]-p0)/(einsum('ijl,kl->ijk',(-lab),cross
(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4686: RuntimeWarning: divide by zero encountered in di
vide
  u=einsum('ijkl,ijkl->ijk',cross(p02[None,None,:,:],(-lab)[:,:,None,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4686: RuntimeWarning: invalid value encountered in div
ide
  u=einsum('ijkl,ijkl->ijk',cross(p02[None,None,:,:],(-lab)[:,:,None,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4687: RuntimeWarning: divide by zero encountered in di
vide
  v=einsum('ijkl,ijkl->ijk',cross((-lab)[:,:,None,:],p01[None,None,:,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4688: RuntimeWarning: invalid value encountered in add
  condition=(t>=0)&(t<=1)&(u>=0)&(u<=1)&(v>=0)&(v<=1)&(u+v<1)
C:\openscad\openscad-main\openscad1.py:4690: RuntimeWarning: invalid value encountered in mul
tiply
  a=(la[:,None,:,None,:]+lab[:,None,:,None,:]*t[:,None,:,:,None])
```

cylinder-with-star-pocket

In [8]:
```
# cylinder with star pocket

t=2 # thickness
n=100 # number of segments of circle
s=5 # number of sides of the star
d=20 # outer diameter of the star
h=50 # height of the star prism
cir1=circle(d,s=(s+1))
cir2=c3t2(q_rot([f"z{360/(s+1)/2}"],circle(d/4,s=(s+1))))
sec1=array(c2t3([cir1,cir2]))
sec1=sec1.transpose(1,0,2).reshape(-1,3)
sec1=sec1
sec1=[(sec1[i]+[0,0,t/1.5]).tolist() if i%2==0 else (sec1[i]+[0,0,t]).tolist() for i in range
```

```
sec1=corner_radius(sec1,20)
sol1=translate([0,0,40],q_rot(["y90"],linear_extrude(m_points(sec1,1.1),h)))

cir=circle(20,s=n)
path=corner_radius(pts1([[t/2,0,t/2],[0,80,t/2-.001],[-t,0,t/2-.001],[0,-80,t/2]]),10)
sol2=prism(cir,path)
sol2=sol2+[sol2[0]]

fillet1=cpo(ip_fillet(sol2,flip(sol1),t/2,-t/2))[:-1]
fillet2=cpo(ip_fillet(flip(sol2),sol1,t/2,-t/2))[:-1]
sol3=flip([translate([5,0,0],fillet1[0])]+fillet1+flip(fillet2)+[translate([-5,0,0],fillet1[0

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>


difference(){{
{swp_c(sol2)}
{swp(sol3)}
}}

''')
```

```
C:\openscad\openscad-main\openscad1.py:4682: RuntimeWarning: invalid value encountered in div
ide
  u=einsum('ijkl,ijkl->ijk',cross(p02[None,None,:,:],(-lab)[:,:,None,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
```

lamp

In [29]:

```
# lamp

n=20 #number of strands in the lamp
t=5 # thickness of each strand
path=[[42,0],[62,50],[25,100],[25,180]]

path1=cytz(bezier(path,100))

path2=[q([0,0,1],path1[i],i/(len(path1)-1)*(180+1.8)) for i in range(len(path1)-1)]

sol=[]
for i in range(len(path2)):
    theta=ang(path2[i][0],path2[i][1])
    sol.append(translate(path2[i],q_rot([f'z{theta}'], \
            oset(square(t,center=True),i/len(path2)*-1.5))))
sol=q_rot(['z0'],sol)
```

```
c1=circle(45)
c2=circle(30)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
for(i=[0:360/{n}:359])
rotate([0,0,i])
{{
{swp(sol)}
//p_line3d({path2},.5);
mirror([0,1,0])
{swp(sol)}
//p_line3d({path2},.5);

}}
linear_extrude(2)
difference()
{{
polygon({c1});
polygon({c2});

}}
''')
```

samsung-tab-s6-holder

In [6]:
```
# samsung tab s6 holder to hang in car back seat

sec=corner_radius(pts1([[0,0,.1],[124,0,3],[27*cos(45*pi/180),27*sin(45*pi/180),1],
             [15*cos(135*pi/180),15*sin(135*pi/180),1],
             [5*cos((180+45)*pi/180),5*sin((180+45)*pi/180),1],
             [10*cos(-45*pi/180),10*sin(-45*pi/180),1],
             [17*cos((180+45)*pi/180),17*sin((180+45)*pi/180),1],
             [10*cos(135*pi/180),10*sin(135*pi/180),1],
             [8*cos(225*pi/180),8*sin(225*pi/180),1],[20*cos(135*pi/180),20*sin(135*pi/180),1
             [8*cos(45*pi/180),8*sin(45*pi/180),1],
             [105*cos(135*pi/180),105*sin(135*pi/180),1],
             [8*cos(225*pi/180),8*sin(225*pi/180),1],
             [20*cos(135*pi/180),20*sin(135*pi/180),1],
             [8*cos(45*pi/180),8*sin(45*pi/180),1],[10*cos(135*pi/180),10*sin(135*pi/180),1],
             [17*cos(45*pi/180),17*sin(45*pi/180),1],[10*cos(-45*pi/180),10*sin(-45*pi/180),1
             [5*cos(45*pi/180),5*sin(45*pi/180),1],[15*cos(135*pi/180),15*sin(135*pi/180),1],
             [21*cos(225*pi/180),21*sin(225*pi/180),1],[0,30,2],[-4,0,1]]),10)
```

```
sec1=corner_radius(pts1([[0,0,2],[17,0,2],[0,85,2],[-17,17,2]]),5)
path1=[[0,0],[0,6]]
sol=translate([123.5,7.7,30],q_rot(["x90","z45"],f_prism(sec1,path1)))


sol1=translate([5,129,130],q_rot(["x90","z45"],f_prism(sec1,path1)))

sec2=corner_radius(pts1([[0,0,4],[10,0,4],[0,40,4],[-10,0,4]]),5)
path2=[[0,0],[0,8]]
sol2=translate([-0.25,140,40],q_rot(["x90","z90"],f_prism(sec2,path2)))

sol3=translate([-0.25,140,170],q_rot(["x90","z90"],f_prism(sec2,path2)))

sec4=corner_radius(pts1([[0,0,0],[15,0,5],[0,90,5],[-15,0,0]]),5)
path4=[[0,0],[0,3]]
sol4=translate([90,35,0],q_rot(["z45"],f_prism(sec4,path4)))

sec5=corner_radius(pts1([[0,0],[120,0,0],[32*cos(135*pi/180),32*sin(135*pi/180),1],
              [8*cos(45*pi/180),8*sin(45*pi/180),1],
              [105*cos(135*pi/180),105*sin(135*pi/180),1],[8*cos(225*pi/180),8*sin(225*pi/180
              [33*cos(135*pi/180),33*sin(135*pi/180),0]]),5)

sec6=corner_radius(pts1([[0,0,5],[90,0,5],[0,110,5],[-90,90,5]]),5)
path6=[[0,0],[0,7]]

sol6=translate([15,6,25],q_rot(["x90"],f_prism(sec6,path6)));
sol7=translate([-1,15,25],q_rot(["x90","z90"],f_prism(sec6,path6)));
sol8=translate([94,30,25],q_rot(["x90","z135"],f_prism(sec6,path6)));

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
rotate([90,0,0])
{{
difference(){{
difference(){{
linear_extrude(250)
polygon({sec});

translate([0,0,-.05])
linear_extrude(250.1)
polygon({oset(sec,-4.5)});
}}

//color("blue")
{swp(sol)}
//color("blue")
{swp(sol1)}
//color("blue")
{swp(sol2)}
//color("blue")
{swp(sol3)}
//color("blue")
{swp(sol6)}
//color("blue")
{swp(sol7)}
//color("blue")
{swp(sol8)}
}}

//color("magenta")
{swp(sol4)}
}}
''')
```

business-card-holder

In [8]:

```
# business card holder

sec=corner_radius(pts1([[0,0,1],[95,0,1],[0,10,1],[-95,0,1]]),10)

sol2=linear_extrude(oset(sec,1),1);

sec1=corner_radius(pts1([[10,0,5],[50,0,5],[10,30],[-70,0]]),10);

sol3=translate([12.5,2,21],q_rot(["x90"],linear_extrude(sec1,5)));

# difference(){
# union(){
# sol4=swp_prism_h(prism1,prism)
# swp(prism2);}
# swp(prism3);}


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
render(){{
difference(){{
linear_extrude(50)
difference(){{
polygon({oset(sec,1)});
polygon({sec});
}}

{swp(sol3)}
}}
{swp(sol2)}
```

```
}}
''')
```

m10

In [31]:
```
p0,p1,p6,p7=tctpf(7.5,17.5,[14.5,0],[0,0])
p2,p3,p4,p5=tctpf(17.5,7.5,[0,0],[-14.5,0])
sec1=arc_2p(p1,p2,17.5,-1)+arc_2p(p3,p4,7.5,-1)+arc_2p(p5,p6,17.5,-1)+arc_2p(p7,p0,7.5,-1)

path1=corner_radius(pts1([[-17,0],[17,0],[0,5.5],[-17,0]]))
sol1=f_prism(sec1,path1)

sec2=circle(10)
path2=cr_3d([[0,0,0.001,0],[0,0,29-.001,17.5],[-44+.001,0,0,0]],20)

sol2=align_sol_1(path_extrude_open(sec2,path2))

sec3=circle(39/2)
path3=corner_radius(pts1([[-39/2+.5,0],[39/2-.5,0],[0,4],[-39/2+.5,0]]),10)
sol3=f_prism(sec3,path3)
sol3=flip(sol2vector([1,0,0],sol3,[-44,0,29]))

fillet1=flip(ip_fillet(sol1,sol2,1.5,-1.5))
fillet2=ip_fillet(sol3,flip(sol2),1.5,1.5)

sol4=align_sol_1(path_extrude_open(circle(13/2),path2))
sol4=swp_prism_h(sol2,sol4)

sol5=translate([0,0,-.25],linear_extrude(circle(10-.5),6))
sol6=flip(sol2vector([1,0,0],sol5,[-44,0,29]))
sol7=translate([0,0,-.25],linear_extrude(circle(2.5,[15,0]),5.5))
sol7=[q_rot([f'z{i}'],flip(sol7)) for i in [0,90,180,270]]
sol7=[sol2vector([1,0,0],p,[-44,0,29]) for p in sol7]

sol8=translate([0,0,-.25],linear_extrude(circle(3,[14.5,0]),6))
```

```python
sol8=[q_rot([f'z{i}'],sol8) for i in [0,180]]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

//color("blue")p_line({sec1},.1);
sol8={sol8};
difference(){{
{swp(sol1)}
{swp(sol5)}
for(i=[0,1])swp(sol8[i]);

}}
{swp_c(sol4)}
sol7={sol7};
difference(){{
{swp(sol3)}
{swp(sol6)}
for(i=[0,1,2,3])swp(sol7[i]);
}}
{swp_c(fillet1)}
{swp_c(fillet2)}

''')
```

```
C:\openscad\openscad-main\openscad1.py:4684: RuntimeWarning: invalid value encountered in div
ide
  t=einsum('kl,ijkl->ijk',cross(p01,p02),la[:,:,None]-p0)/(einsum('ijl,kl->ijk',(-lab),cross
(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4685: RuntimeWarning: divide by zero encountered in di
vide
  u=einsum('ijkl,ijkl->ijk',cross(p02[None,None,:,:],(-lab)[:,:,None,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4686: RuntimeWarning: divide by zero encountered in di
vide
  v=einsum('ijkl,ijkl->ijk',cross((-lab)[:,:,None,:],p01[None,None,:,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4686: RuntimeWarning: invalid value encountered in div
ide
  v=einsum('ijkl,ijkl->ijk',cross((-lab)[:,:,None,:],p01[None,None,:,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4687: RuntimeWarning: invalid value encountered in add
  condition=(t>=0)&(t<=1)&(u>=0)&(u<=1)&(v>=0)&(v<=1)&(u+v<1)
C:\openscad\openscad-main\openscad1.py:4684: RuntimeWarning: divide by zero encountered in di
vide
  t=einsum('kl,ijkl->ijk',cross(p01,p02),la[:,:,None]-p0)/(einsum('ijl,kl->ijk',(-lab),cross
(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4685: RuntimeWarning: invalid value encountered in div
ide
  u=einsum('ijkl,ijkl->ijk',cross(p02[None,None,:,:],(-lab)[:,:,None,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4689: RuntimeWarning: invalid value encountered in mul
tiply
  a=(la[:,None,:,None,:]+lab[:,None,:,None,:]*t[:,None,:,:,None])
```

m35

In [9]:
```
# m35
t0=time.time()

p0=[15,0]
p1=[15,45]
cir1=circle(7.5,[0,75-7.5])
p2=p_cir_t(p1,cir1)
p4=[-15,45]
p3=cir_p_t(cir1,p4)
arc1=arc_2p(p2,p3,7.5,-1,45)
p5=[-15,0]
p0,p1,arc1,p4,p5=[[15,0,0]],[[15,45,1]],c2t3(arc1),[[-15,45,1]],[[-15,0,0]]
sec=corner_radius(p0+p1+arc1+p4+p5,10)
sec=equidistant_pathc(sec,500)

l1=[[0,5],[0,70]]
l1=surround(l1,.001)
l1=equidistant_pathc(l1,500)
l1=align_sec_1(sec,l1)[1]
sec1=translate([0,.1,0],slice_sol([sec,l1],50))

path=corner_radius(pts1([[0,0],[45,0,1],[45*cos(d2r(30)),45*sin(d2r(30))]]),50)
path=q_rot(['x90','z90'],path)
surf1=[wrap_around(p,path) for p in sec1]
surf2=surf_offset(surf1,-4)
sol=translate([0,0,9+4],q_rot(['z-90'],flip(surf2)+surf1+[flip(surf2)[0]]))
```

```
sec2=[circle(.5,[0,75-7.5]),circle(3.75,[0,75-7.5])]
surf3=flip([wrap_around(p,translate([0,0,.001],path)) for p in sec2])
surf4=surf_offset(surf3,-4.1)
sol1=translate([0,0,9+4],q_rot(['z-90'],flip(surf3)+surf4))

path=cytz(pts([[0,9],[25.5+19.5,0],[(30-7.5)*cos(45*pi/180),(30-7.5)*sin(45*pi/180)]]))
# sec1=c2t3(m_points_o(pts([[-15,0],[30,0],[0,5],[-30,0]]),1))

sec3=[[-30,-15]]+arc_2p([0,-15],[0,15],15,-1,20)+[[-30,15]]
p6=l_cir_ip([[-30,-15+10.5],[0,-15+10.5]],circle(7.5))
p7=l_cir_ip([[-30,15-10.5],[0,15-10.5]],circle(7.5))
sec4=[[-30,-15+10.5]]+arc_long_2p(p6[0],p7[0],7.5,-1,30)+[[-30,15-10.5]]

sec5=circle(6)
path1=corner_radius(pts1([[0,-15.1],[0,4.6],[-3,0],[0,21],[3,0],[0,4.6]]),5)
sol2=translate([-30+12,0,11.25],q_rot(['x-90'],f_prism(sec5,path1)))


sec6=[[25.5+9,-15.1]]+arc_2p([25.5+9,0],[25.5,0],4.5,-1)+[[25.5,-15.1]]
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
//color("blue")p_line3dc({sol[-1]},.2,1);
difference(){{
{swp_c(sol)}
linear_extrude(22.5)polygon({sec4});
{swp(flip(sol1))}
linear_extrude(22.5)polygon({sec6});

}}
difference(){{
linear_extrude(22.5)
difference(){{
polygon({sec3});
polygon({sec4});
}}
{swp(sol2)}
}}

''')
t1=time.time()
t1-t0
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[9], line 25
     23 path=q_rot(['x90','z90'],path)
     24 surf1=[wrap_around(p,path) for p in sec1]
---> 25 surf2=surf_oset(surf1,-4)
     26 sol=translate([0,0,9+4],q_rot(['z-90'],flip(surf2)+surf1+[flip(surf2)[0]]))
     28 sec2=[circle(.5,[0,75-7.5]),circle(3.75,[0,75-7.5])]

NameError: name 'surf_oset' is not defined
```

l_cir_ip

In [110…

```
# example of function l_cir_ip(line, cir)
p0=[-30,-15+10.5]
p1=[0,-15+10.5+10]
line=[p0,p1]
cir=circle(7.5)
p2=l_cir_ip(line,cir)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%p_line({cir},.1);
%p_line({[p0,p1]},.1);
color("magenta")points({[p0,p1]},.5);
color("cyan")points({[p2[0]]},.5);
color("blue")points({[p2[1]]},.5);

''')
```

fillet_line_circle

In [14]:

```
# example of fillet_line_circle(l1, c1, r2, cw=-1, option=0, s=50)

line=[[0,0],[0,60]]
cir1=circle(10,[-10,30])
cir2=circle(5,[-10,30])
fillet1=fillet_line_circle(line,cir1,4.5,-1,1,10)
fillet2=flip(fillet_line_circle(flip(line),cir1,4.5,1,1,10))
p0,p1,p2,p3,p4,p5,p6,p7,p8,p9=line[0],fillet1[0],fillet1[-1],fillet2[0],fillet2[-1],line[1],[
sec1=[p0]+fillet1[:-1]+arc_long_2p(p2,p3,10,1,50)+fillet2[1:]+[p5]+[p6]+[p7]
sec2=[p0]+fillet1[:-1]+arc_long_2p(p2,p3,10,1,50)+fillet2[1:]+[p5]+[p8]+[p9]
sec3=c3t2(translate([-45+5,5,0],square([5,49])))
sec4=c3t2(translate([45-10,5,0],square([5,49])))



with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

linear_extrude(10)
difference(){{
polygon({sec1});
polygon({sec3});
}}

color("cyan")
linear_extrude(10)
difference(){{
polygon({sec2});
polygon({cir2});
polygon({sec4});
}}
''')
```

In [26]:

```
# example of fillet_line_circle(l1, c1, r2, cw=-1, option=0, s=50)

line=[[-10,23],[30,13]]
cir1=circle(10,[10,12])
r2=5
s=20
fillet1=fillet_line_circle(line,cir1,r2,cw=-1)
fillet2=fillet_line_circle(flip(line),cir1,r2,cw=1)
fillet3=fillet_line_circle(flip(line),cir1,r2,cw=-1,option=1)
fillet4=fillet_line_circle(line,cir1,r2,cw=1,option=1)
fillet5=fillet_line_circle_internal(line,cir1,1,1,0,20)
fillet6=fillet_line_circle_internal(line,cir1,r2,-1,1,20)
fillet7=fillet_line_circle_internal(flip(line),cir1,1,-1,0,20)
fillet8=fillet_line_circle_internal(flip(line),cir1,r2,1,1,20)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue",.1)p_line({line},.3);
color("violet",.2)p_line({cir1},.3);
color("cyan")p_lineo({fillet1},.3);
color("blue")p_lineo({fillet2},.3);
color("magenta")p_lineo({fillet3},.3);
color("green")p_lineo({fillet4},.3);
color("blue")p_lineo({fillet5},.3);
color("magenta")p_lineo({fillet6},.3);
color("cyan")p_lineo({fillet7},.3);
color("green")p_lineo({fillet8},.3);

''')
```

equidistant_pathc

In [27]:
```
a=circle(5,s=200)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
points({a},.2);
color("blue")points({equidistant_pathc(a,20)},.2);


''')
```

artifact

In [5]:
```
# it takes around 60 sec for calculations

t0=time.time()

stages =200

stage_height = 1.25

rad = 50

f1 = 25

f2 = 25

phase1 = 0

phase2 = 180

height_depth=5

depth1 = 20
```

```
depth2 = 20

thickness = 2

bottom_thickness = 3

myslices = 5

angle_step=.5

var=1

def pauw(x,p):
    return sign(x)*abs(x)**p

def f(i,stages):
    return sin(d2r(i/stages * 120))**2 * 7 + 1

def a(i,stages,var,height_depth):
    return (sin(d2r((i/stages*360*f(i,stages))%360)) * 0.5 + 0.5) * (var * height_depth)


# generate outer points

# points_base = [for (i = [0:1:stages])
#                let(f = sin(i/stages * 120)^2 * 7 + 1, var = 1 , a=((sin((i/stages*360*f)%36
#                [for(j = [0:angle_step:360-angle_step])
#                 [sin(j) * (rad+a+(pauw(sin(j *f1+phase1),0.5)*0.5+0.5)*depth1*i/stages+(pau
#                  cos(j) *(rad+a+(pauw(sin(j *f1+phase1),0.5)*0.5+0.5)*depth1*i/stages+(pauw
#                  i*stage_height]]]

points_base=[[
    [
        sin(d2r(j)) * (rad+a(i,stages,var,height_depth)+(pauw(sin(d2r(j *f1+phase1)),0.5)*0.5
        cos(d2r(j)) * (rad+a(i,stages,var,height_depth)+(pauw(sin(d2r(j *f1+phase1)),0.5)*0.5
        i*stage_height
    ]
    for j in arange(0,360,angle_step)] for i in range(stages+1)]


p1,p2=[],[]
for i in range(stages):
    points_base1= flip(c3t2(points_base[i]))#flip(c3t2(points_base[i])) if cw(c3t2(points_bas
    points_base2=oset(points_base1,-thickness)
    p1.append(translate([0,0,i*stage_height],points_base1))
    p2.append(translate([0,0,i*stage_height],points_base2))

sol=swp_prism_h(p1,p2)

sol1=[p1[0],p1[2]]

with open('trial.scad','w+') as f:
    f.write(f'''

{swp_c(sol)}
{swp(sol1)}
''')

t1=time.time()
t1-t0
```

Out[5]:

```
71.87775683403015
```

wrap_around

In [93]:

```
# example of function wrap_around(sec,path)
t0=time.time()

sec=equidistant_pathc(corner_radius(pts1([[-10,0,1],[20,0,1],[0,15,1],[-10,10,2],[-10,-10,1]]
sec=equidistant_pathc(sec,200)
l1=equidistant_path([[0,2],[0,22]],10)
l1=equidistant_pathc(surround(l1,.0001,500),200)
l1=align_sec_1(sec,l1)[1]
sol1=translate([0,.1,0],slice_sol([sec,l1],20))
path=cr_3d([[0,0,0,0],[0,15,0,2],[0,-4,8,3],[0,10,0,0]],20)
sol2=[wrap_around(p,path) for p in sol1]
sol3=surf_offset(sol2,.5)
sol4=flip(sol2)+sol3+[flip(sol2)[0]]


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
difference(){{
{swp_c(sol4)}
{swp(o_solid([0,1,0],circle(2),10,7,0,5))}
```

```
}}
''')
t1=time.time()
t1-t0
```

Out[93]:

```
0.7561991214752197
```

In [110…

```
# example of function wrap_around(sec,path) work flow


sec=equidistant_pathc(corner_radius(pts1([[-10,0.1,1],[20,0,1],[0,15,1],[-10,10,2],[-10,-10,1


path1=corner_radius(pts1([[0,0],[15,0,1],[-16,15]]),50)
path2=circle(5,s=200)
path3=corner_radius(pts1([[0,0],[5,0,1],[0,5,1],[3,0,1],[0,-5,1],[10,0]]),10)
path1=q_rot(['x90','z90'],path1)
path2=q_rot(['x90','z90'],path2)
path3=q_rot(['x90','z90'],path3)

sec1=wrap_around(sec,path1)
sec2=wrap_around(sec,path2)
sec3=wrap_around(sec,path3)

path4=corner_radius(pts1([[6,2],[-6,0,1],[0,-2.001,1],[25,0]]),10)
path4=q_rot(['x90','z90'],path4)

sec4=translate([0,9,0],q_rot(['z-45'],sec1))
sec4=wrap_around(sec4,path4)

sec5=translate([0,9,0],q_rot(['z90'],translate([0,-9,0],sec4)))
sec5=wrap_around(sec5,path4)

sec6=q_rot(['z-45'],translate([0,-9,0],sec5))


with open('trial.scad','w+') as f:
    f.write(f'''
```

```
include<dependencies2.scad>

translate([30,40,0]){{
p_line3d({path2},.1);
color("magenta")p_line3dc({sec2},.1);}}

translate([30,60,0]){{
p_line3d({path3},.1);
color("magenta")p_line3dc({sec3},.1);}}

color("blue")p_line3dc({sec},.1);
translate([0,30,0]){{
color("blue")p_line3d({path1},.1);
color("magenta")p_line3dc({sec1},.1);}}


translate([0,50,0]){{
color("blue")p_line3d({path4},.1);
color("magenta")p_line3dc({sec4},.1);}}

translate([0,80,0]){{
color("blue")p_line3d({path4},.1);
color("magenta")p_line3dc({sec5},.1);}}

translate([0,110,0]){{
//p_line3d({path4},.1);
color("magenta")p_line3dc({sec6},.1);}}

''')
```

In [10]:

```
# wrap_around example 4
t0=time.time()

sec0=corner_radius(pts1([[-10,0.1,1],[20,0,1],[0,15,1],[-10,10,2],[-10,-10,1]]),20)
cp=array(oset(sec0,-10)).mean(0).tolist()
sec=equidistant_pathc(corner_radius(pts1([[-10,0.1,1],[20,0,1],[0,15,1],[-10,10,2],[-10,-10,1
sec1=cpo([sort_points(sec,[cp]),sec])
sec1=cpo([ls(p,50) for p in sec1 ])+[sec]


path1=corner_radius(pts1([[0,0],[15,0,1],[-16,15]]),50)
path1=q_rot(['x90','z90'],path1)
```

```
sec1=[wrap_around(p,path1) for p in sec1]

path4=corner_radius(pts1([[7,5],[-7,-5,1],[45,0]]),10)
path4=q_rot(['x90','z90'],path4)

sec2=translate([0,9,0],q_rot(['z-45'],sec1))
sec2=[wrap_around(p,path4) for p in sec2]

sec3=translate([0,9,0],q_rot(['z90'],translate([0,-9,0],sec2)))
sec3=[wrap_around(p,path4) for p in sec3]

sec3=q_rot(['z-45'],translate([0,-9,0],sec3))
sec4=surf_offset(flip(sec3),.5)
sol=sec3+sec4+[sec3[0]]
sol=translate([0,3,0],sol)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sol)}


''')
t1=time.time()
t1-t0
```

Out[10]: 3.4748148918151855

ball-bearing

In [112…

```
#  ball bearing

sec=corner_radius(pts1([[31,.5,0],[.5,-.5,0],[9.5,0,1],[0,15,1],[-9.5,0,0],[-.5,-.5,0]]),10)
sec1=corner_radius(pts1([[16,.5,0],[.5,-.5],[9,0,0],[0.5,.5,0],[0,14,0],[-.5,.5,0],[-9,0,0],[
sec2=circle(7,[28.5,7.5])

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

rotate_extrude($fn=200)
difference(){{
```

```
union(){{
polygon({sec});
polygon({sec1});
}}
polygon({sec2});
}}

for(i=[0:360/12:359])
rotate([0,0,i])
translate([28.5,0,7.5])
sphere(6.8,$fn=100);

''')
```

mobile-phone-stand

In [11]:
```
# mobile phone stand with application of functions wrap_around and surf_offset

t0=time.time()
sec1=corner_radius(pts1([[-75,20,2],[75,-20,280],[75,20,2],[0,70,2],[-75,7,280],[-75,-7,2]]),
cp1=array(oset(sec1,-35)).mean(0)
sec1=m_points(sec1,.5)
sec2=cpo([sort_points(sec1,[cp1]),sec1])
sec2=cpo([ls(p,60)for p in sec2])+[sec1]
path1=corner_radius(pts1([[0,60*sin(d2r(60)),0],[60*cos(d2r(-60)),60*sin(d2r(-60)),5+1],[15+1
path1=path1
path1=q_rot(['x90','z90'],path1)
```

```
surf1=[wrap_around(p,path1) for p in sec2]
surf2=surf_offset(flip(surf1),4)
sol=surf1+surf2

sec1=corner_radius(pts1([[-70,20,2],[70,-20,200],[70,20,2],[0,80,2],[-140,0,2]]),30)
cp1=array(oset(sec1,-25)).mean(0)
sec1=m_points(sec1,.5)
sec2=cpo([sort_points(sec1,[cp1]),sec1])
sec2=cpo([ls(p,60)for p in sec2])+[sec1]

path2=corner_radius(pts1([[0,0],[95,0,4+1],[100*cos(d2r(120)),100*sin(d2r(120))]]),50)
path2=q_rot(['x90','z90'],path2)
surf1=[wrap_around(p,path2) for p in sec2]
surf2=surf_offset(flip(surf1),4)
sol1=surf1+surf2

sol2=[sol[57]]+slice_sol(sol[60:62],3)+[sol[63]]

p0,p1,p2,p3,p4,p5=sol2
fillet1=cpo(convert_3lines2fillet(p2,p0,p1))[:-1]
fillet2=cpo(convert_3lines2fillet(p5,p3,p4))[:-1]

sol3=flip(fillet1)+flip(fillet2)
sol4=sol[:57]+sol3+sol[64:]

sol2=[sol1[57]]+slice_sol(sol1[60:62],3)+[sol1[63]]

p0,p1,p2,p3,p4,p5=sol2
fillet1=cpo(convert_3lines2fillet(p2,p0,p1))[:-1]
fillet2=cpo(convert_3lines2fillet(p5,p3,p4))[:-1]

sol3=flip(fillet1)+flip(fillet2)
sol5=sol1[:57]+sol3+sol1[64:]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

translate([0,40-4.625,0])
{swp(sol4)}
translate([0,-25.006125,0])
{swp(sol5)}


''')

t1=time.time()
t1-t0
```

Out[11]:

```
18.680732250213623
```

In [30]:

```
# mobile phone stand with application of functions wrap_around and surf_offset

t0=time.time()
sec1=corner_radius(pts1([[-75,20,2],[75,-20,280],[75,20,2],[0,70,2],[-75,7,280],[-75,-7,2]]),
cp1=array(oset(sec1,-35)).mean(0)
sec1=m_points(sec1,.5)
sec2=cpo([sort_points(sec1,[cp1]),sec1])
sec2=cpo([ls(p,60)for p in sec2])+[sec1]
path1=corner_radius(pts1([[0,60*sin(d2r(60)),0],[60*cos(d2r(-60)),60*sin(d2r(-60)),5+1],[15+1
path1=path1
path1=q_rot(['x90','z90'],path1)

surf1=[wrap_around(p,path1) for p in sec2]
surf2=surf_offset(flip(surf1),3)
sol=surf1+surf2

sec1=corner_radius(pts1([[-70,20,2],[70,-20,200],[70,20,2],[0,80,2],[-140,0,2]]),30)
cp1=array(oset(sec1,-25)).mean(0)
sec1=m_points(sec1,.5)
sec2=cpo([sort_points(sec1,[cp1]),sec1])
sec2=cpo([ls(p,60)for p in sec2])+[sec1]

path2=corner_radius(pts1([[0,0],[95,0,4+1],[100*cos(d2r(120)),100*sin(d2r(120))]]),50)
path2=q_rot(['x90','z90'],path2)
surf1=[wrap_around(p,path2) for p in sec2]
surf2=surf_offset(flip(surf1),3)
sol1=surf1+surf2

sol2=[sol[57]]+slice_sol(sol[60:62],3)+[sol[63]]

p0,p1,p2,p3,p4,p5=sol2
fillet1=cpo(convert_3lines2fillet(p2,p0,p1))[:-1]
fillet2=cpo(convert_3lines2fillet(p5,p3,p4))[:-1]

sol3=flip(fillet1)+flip(fillet2)
sol4=sol[:57]+sol3+sol[64:]

sol2=[sol1[57]]+slice_sol(sol1[60:62],3)+[sol1[63]]

p0,p1,p2,p3,p4,p5=sol2
```

```
fillet1=cpo(convert_3lines2fillet(p2,p0,p1))[:-1]
fillet2=cpo(convert_3lines2fillet(p5,p3,p4))[:-1]

sol3=flip(fillet1)+flip(fillet2)
sol5=sol1[:57]+sol3+sol1[64:]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

translate([0,40-4.625,0])
{swp(sol4)}
translate([0,-26.2,0])
{swp(sol5)}


''')

t1=time.time()
t1-t0
```

Out[30]: 18.951167821884155

In [3]:

```
#  car mobile stand
sec=corner_radius(pts1([[-160/2-4,-15/2-4,23/2-.1],[160+2*4,0,23/2-.1],[0,15+2*4,23/2-.1],[-1
sol=o_solid([0,1,sqrt(3)],sec,60)
sol1=surf_offset(sol,-4)
sol2=swp_prism_h(sol,sol1)
surf1=translate([0,0,10],plane([0,0,1],200))
ip1=ip_sol2sol(surf1,sol,0)
surf2=ip1[:22]+translate([0,100,0],ip1[22:44])
surf3=translate([0,0,-4],surf2)
sol3=[surf3]+[surf2]
sol4=o_solid([0,0,1],square(200,True),20,-10)

sec1=corner_radius(pts1([[-130/2,0],[130,0],[5,60],[-130-2*5,0]]),10)
sol5=o_solid([0,-sqrt(3),1],sec1,10,5,0,10)

sol6=[ip1[22:]]+[translate([0,2,0],ip1[22:])]+[translate([0,1,sqrt(3)],ip1[22:])]
fillet1=convert_3lines2fillet(translate([0,5,0],ip1[22:]),translate([0,2.4,4.34],ip1[22:]),ip
with open('trial.scad','w+') as f:
    f.write(f'''
difference(){{
```

```
{swp_c(sol2)}
{swp(sol4)}
{swp(sol5)}
}}
//%{swp(surf1)}
//color("magenta")points({ip1[:22]},.5);
{swp(sol3)}
{swp(fillet1)}
''')
```

back-camera-clamp

In [118…

```
# back camera clamp

res=.5
sec=corner_radius(pts1([[-37/2,0.1,.5],[37,0,.5],[0,15,.5],[-5,24,13.5],[-27,0,13.5],[-5,-24,
cp1=array(oset(sec,-17)).mean(0)
sec1=[sort_points(m_points(sec,res),[cp1])]+[m_points(sec,res)]
sec2=cpo([ls(p,20) for p in cpo(sec1)])+[m_points(sec,res)]

path=corner_radius(pts1([[0,0],[15,0,3.5],[15,41.21]]),10)
path=q_rot(['x90','z90'],path)

sec3=[wrap_around(p,path) for p in sec2]
sec4=surf_offset(flip(sec3),2)

sol=sec3+sec4

sec5=translate([0,0,-1],c2t3([circle(.1,[0,28])]+[circle(9,[0,28])]))
sec5=[wrap_around(p,path) for p in sec5]
sec6=surf_offset(flip(sec5),4)
```

```
sol1=sec5+sec6

cyl1=cylinder(d=4,h=5)

slit=q_rot(['x70'],translate([-.5,15,-17],linear_extrude(square([1,20]),10)))

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
rotate([-70,0,0])
translate([0,-15,0])
difference(){{
{swp(sol)}
{swp(sol1)}

for(i=[-27/2,27/2])
translate([i,5,-2])
{swp(cyl1)}

{swp(slit)}
}}
''')
```

align_sol

In [119…

```
# example of function align_sol(sol,angl)

sqr1=circle(5,s=5)
pent1=circle(5,s=6)

sqr1=c2t3(sort_points(pent1,sqr1))
pent1=translate([0,0,10],pent1)
```

```
sol=[sqr1]+[pent1]
sol=align_sol(sol,1)
sol1=slice_sol(sol,100)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sol1)}
color("blue")p_line3dc({sol[0]},.05);
color("blue")p_line3dc({sol[1]},.05);

''')
```

In [120…

```
# example of function align_sol(sol,angl)


sqr1=c2t3(equidistant_pathc(circle(5,s=5),200)[:200])
```

```
pent1=equidistant_pathc(circle(5,s=6),200)[:200]
pent1=translate([0,0,10],pent1)
sol=[sqr1]+[pent1]
sol=align_sol_1(sol)
sol1=slice_sol(sol,10)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sol1)}
color("blue")p_line3dc({sol[0]},.05);
color("blue")p_line3dc({sol[1]},.05);
''')
```

In [121…

```
sqr1=circle(5,s=5)
pent1=circle(5,s=6)
```

```
sqr1,pent1=c2t3(equate_points(sqr1,pent1))
pent1=translate([0,0,10],q_rot(['y-30'],pent1))
sol=[sqr1]+[pent1]
sol=align_sol(sol,.1)
sol1=slice_sol(sol,100)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sol1)}
color("blue")p_line3dc({sol[0]},.05);
color("blue")p_line3dc({sol[1]},.05);
color("magenta")p_line3dc({pent1},.05);


''')
```

In [28]:

```
# example of function align_sol(sol, ang=10)
t0=time.time()

path=cr_3d([[0,0,0,3],[15,0,0,4],[5,3,15,3],[0,10,0,3],[-5,3,-15,4],[-15,0,0,3]],10)
sec=pts([[-1.5,-1.25],[3,0],[-1.5,2.5]])
sol=path_extrude_closed(sec,path)
# sol=slice_sol(sol,2)
sol=align_sol(sol,1)

sol=slice_sol(sol,1)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp_c(sol)}


''')
t1=time.time()
t1-t0
```

Out[28]:

```
2.058917999267578
```

In [29]:

```
# approach to align absolutely different shapes

sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),30)
sec1=scl2d_c(corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7]

sec2=c2t3(equidistant_pathc(sec,100))
sec3=translate([0,0,20],equidistant_pathc(sec1,100))
sol=[sec2,sec3]
sol=slice_sol(align_sol(sol),50)


t0=time.time()
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
difference(){{
{swp(sol)}
//cube(10);
}}

//color("blue")p_line3dc({sol[0]},.05);
//color("cyan")p_line3dc({sol[-1]},.05);

''')
```

```
t1=time.time()
t1-t0
```

Out[29]: 0.03751802444458008

align_sol_1

In [124…

```
# example of function align_sol_1(sol)

t0=time.time()

sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
cp1=array(sec).mean(0)


pent1=circle(7,s=6)
pent2=c3t2(q_rot([f'z{360/5/2}'],circle(3.5,s=6)))
sec1=concatenate(cpo([pent1]+[pent2])).tolist()

sec=translate(-cp1,(equidistant_pathc(sec,200)))
sec1=translate([0,0,20],equidistant_pathc(sec1,200))
```

```
sol=slice_sol(align_sol_1([sec,sec1]),20)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

sec={sec};
sec1={sol[1]};
{swp(sol)}
color("blue")points({sol[-1]},.1);
color("blue")points({sol[0]},.1);
//for(i=[0:len(sec)-1])translate(sec[i])linear_extrude(.1)text(str(i),.2);
//for(i=[0:len(sec1)-1])translate(sec1[i])linear_extrude(.1)text(str(i),.2);


''')

t1=time.time()
t1-t0
```

Out[124]:

```
0.08716392517089844
```

In [125…

```
# very fine merging of 2 very different shapes
t0=time.time()
sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
sec1=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),20)
sec1=corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7],[-40,0,

s1=translate([0,0,20],equidistant_pathc(sec,1000))
s2=c2t3(equidistant_pathc(sec1,1000))

s3=slice_sol(align_sol_1([s2]+[s1]),100)
```

```
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

swp({s3});


''')
t1=time.time()
t1-t0
```

Out[125]: 1.7837989330291748

end_cap

In [37]:

```
# example of function path_extrude_open and end_cap

i_t=time.time()
sec=corner_radius(pts1([[-1.5,-1.5,.5],[3,0,.5],[0,3,1.49],[-3,0,1.49]]),10)
path=q_rot(['x-90'],cr_3d([[0,0,0,0],[3,5,10,5],[17,-2,5,6],[1,-10,10,0]],10))
sol=q_rot(['x90'],path_extrude_open(sec,path))
sol=align_sol_1(sol)
sol=slice_sol(sol,10)
```

```
e_cap=end_cap(sol,1)
f3=e_cap[0]
f4=e_cap[1]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

difference(){{
{swp(sol)}
{swp_c(f3)}
{swp_c(f4)}

}}

''')
f_t=time.time()
f_t-i_t
```

```
C:\openscad\openscad-main\openscad1.py:5691: RuntimeWarning: invalid value encountered in div
ide
  u1=v1/norm(v1)
```

Out[37]:

```
1.9497840404510498
```

sec2vector

In [127…

```
# example of function sec2vector(v1,sec)
i_t=time.time()
sec=corner_radius(pts1([[-1.5,-1.5,.5],[3,0,.5],[0,3,.5],[-3,0,.5]]),10)
v1=[1,2,-1]
vector1=[[0,0,0],v1]
sec1=sec2vector(v1,sec)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
// original section
p_line3dc({sec},.05);

//aligned section in cyan color
color("cyan")p_line3dc({sec1},.05);

//vector with whom the section is expected to be aligned with in blue color
```

```
color("blue")p_line3d({vector1},.05);


''')
f_t=time.time()
f_t-i_t
```

Out[127]: 0.005972862243652344

cut_plane

In [38]:

```
# example of function cut_plane(nv,radius,thickness,trns)

t0=time.time()

sec2=corner_radius(pts1([[-25,0],[10,5,5],[10,-3,10],[10,5,5],[10,-8,7],[10,1]]),10)
path2=cytz(corner_radius(pts1([[-35,5,0],[10,8,20],[20,-5,10],[20,8,20],[10,-9,20],[10,1,0]])
surf2=surf_extrude(sec2,path2)
surf3=surf_extrudef(surf2,t=-1)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

difference(){{
{swp(surf3)}
{swp(cut_plane([0,0,1],[100,100],10,14))}
}}

''')
t1=time.time()
total=t1-t0
total
```

Out[38]: 0.07293224334716797

In [30]:

```
sec=[[0,0],[5,0],[0,5]]
path=[[0,0,0],[10,0,0],[5,10,5]]
sol=path_extrude_open(sec,path)
# sol=align_sol_1(sol)
sol2=slice_sol(sol,20)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

difference(){{
{swp(sol2)}

//{swp(cut_plane([1,1,1],30,7,-3))}
}}
''')
```

slice_sol

In [31]:
```
sec=square(5,True)
path=q_rot(['x-90'],[[3,0,0],[0,0,10],[10,0,15],[10,0,25]])
sol=q_rot(['x90'],path_extrude_open(sec,path))
# sol=align_sol(sol)
sol2=slice_sol(sol,10)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
//color("blue")p_line3dc({sec},.1,1);
//color("blue")p_line3d({cytz(path)},.1,1);
//color("cyan")points({cytz(path)},.5);

{swp(sol2)}
//color("magenta")for(p={sol2})p_line3dc(p,.1,1);


''')
```

In [32]:

```
sec=square(5,True)
path=q_rot(['x0'],pts2([[3,0,0],[-3,5,10],[10,-5,5],[0,10,2]]))
sol=path_extrude_open(sec,path)
sol=align_sol(sol,1)
sol2=slice_sol(sol,5)
sol3=offset_sol(sol2,.5,1)
sol4=swp_prism_h(sol3,sol2)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("magenta")p_line3d({path},.1,rec=1);
//color("cyan")for(p={sol2})p_line3dc(p,.1);
{swp_c(sol4)}

''')
```

o_solid

In [33]:
```
# example of function o_solid(nv,sec,thickness,trns1,trns2,trns3)


# sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),30)
# sec=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,5],[-7,5,5]]),10)
sec=corner_radius(pts1([[-15,0,2.4],[0,15,3],[30,0,3],[0,-15,2.4],[5,0,2.4],[0,20,7],[-40,0,7
# sec=corner_radius(pts1([[0,0,1],[10,0,1],[0,5,1],[-10,0,1]]),10)
# sec=circle(10)

sol=o_solid([1,0,0],sec,20,-10,0,0,theta=[0,0,0])
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sol)}
color("blue")p_line({sec},.05);
```

```
''')
```

In [34]:

```
t0=time.time()
sec=corner_radius(pts1([[-5,-5,1],[10,0,1],[0,10,1],[-10,0,1]]),5)
sec1=corner_radius(pts1([[-5,-5,1],[10,0,1],[0,10,1],[-10,0,1]]),5)

path=corner_radius(pts1([[-4,0],[4,0,1],[0,10,1],[-4,0]]),5)
# path=equidistant_path(path,100)
sol1=f_prism(sec,path)

sol2=o_solid([1,0,.1],circle(2,s=15),15,-7,0,10,[-90,0,0])


with open('trial.scad','w+')as f:
    f.write(f'''
    include<dependencies.scad>

{swp(sol1)}
{swp(sol2)}


    ''')
t1=time.time()
t1-t0
```

Out[34]:

```
0.07624149322509766
```

In [40]:

```
#  example of defining normal vectors to a given vector 'v1'

v1=[1,1,sqrt(2)]
u1=v1/norm(v1)
ua=array([0,0,-1]) if u1[2]==0 else array([0,-1,0]) if (u1==[0,0,1]).all() else array([-1,0,0
v2=cross(u1,ua)
u2=v2/norm(v2)
u3=array(q(u2,u1,-90))

u1,u2,u3=array([u1,u2,u3]).tolist()
with open('trial.scad','w+') as f:
```

```
    f.write(f'''
include<dependencies2.scad>


color("blue")p_line3d({[[0,0,0],u1]},.05);
color("magenta")p_line3d({[[0,0,0],u2]},.05);
color("cyan")p_line3d({[[0,0,0],u3]},.05);


''')
```

In [133…

```
with open('trial.scad','w+') as f:
    f.write(f'''


 cylinder (d=30,h=30); // hub.
  linear_extrude (height=30, twist=100, $fn=100)
     for (a=[0:120:359]) rotate (a) translate ([15,-1]) square ([45,2]);



''')
```

ppplane

In [135…

```
# points projected on a plane
t0=time.time()

p0=random.random([10,3])*(20-(-20))+(-20)
loc=[0,10,1]
v1=[2,3,4]

sec=pts([[-50/2,-50/2],[50,0],[0,50],[-50,0]])
plane1=translate(loc,o_solid(v1,sec,.001))


ip1=ppplane(p0,v1,loc)
lines1=array([p0,ip1]).transpose(1,0,2).tolist()

with open('trial.scad','w+') as f:
```

```
    f.write(f'''

include<dependencies2.scad>
//p_line({sec},.05);

color("cyan")p_line3dc({plane1[0]},.1);
 color("blue")points({p0.tolist()},.5);

 color("magenta")points({ip1},.5);

 for(p={lines1})p_line3d(p,.1);

''')
t1=time.time()
t1-t0
```

Out[135]: 0.012294530868530273

ppesec

In [136…

```
# points projected on an enclosed section in 3d space
t0=time.time()

p0=random.random([10,3])*(20-(-20))+(-20)
loc=[0,10,1]
v1=[2,3,4]
```

```
sec=pts([[-50/2,-50/2],[50,0],[0,50],[-50,0]])
plane1=translate(loc,o_solid(v1,sec,.001))


ip1=ppesec(p0,plane1[0])[0]

lines1=array(ppesec(p0,plane1[0])).transpose(1,0,2).tolist()

with open('trial.scad','w+') as f:
    f.write(f'''

include<dependencies2.scad>
//p_line({sec},.05);

color("cyan")p_line3dc({plane1[0]},.1);
 color("blue")points({p0.tolist()},.5);

 color("magenta")points({ip1},.5);
 for(p={lines1})p_line3d(p,.1);

''')
t1=time.time()
t1-t0
```

Out[136]: 0.003537416458129883

In [137…

```
# another example of points projected on an enclosed section in 3d space
t0=time.time()

p0=random.random([10,3])*(20-(-20))+(-20)
v1=[2,3,4]
sec=circle(10)
loc=[0,10,0]
plane1=translate(loc,o_solid(v1,sec,.001))


ip1=ppesec(p0,plane1[0])[0]
lines1=cpo(ppesec(p0,plane1[0]))
with open('trial.scad','w+') as f:
    f.write(f'''

include<dependencies2.scad>
//p_line({sec},.05);

color("cyan")p_line3dc({plane1[0]},.1);
 color("blue")points({p0.tolist()},.5);

 color("magenta")points({ip1},.5);
for(p={lines1})p_line3d(p,.1);

''')
t1=time.time()
t1-t0
```

Out[137]:

```
0.0076160430908203125
```

honeycomb

In [138…

```
# honeycomb structure

sec4=honeycomb(1,6,15)
sec=corner_radius(pts1([[3,2,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),30)
pnts1=[p for p in sec4 if len(pies1(sec,p))==6]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

for(p={sec4})p_line(p,.1);

color("blue")p_line({sec},.1);

color("cyan")for(p={pnts1})p_line(p,.1);


''')
```

In [139…

```
# honeycomb structure with intersection option
t0=time.time()

sec4=honeycomb(1,6,15)
sec=corner_radius(pts1([[3,2,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),30)
# pnts1=[p for p in sec4 if len(pies1(sec,p))==6]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("cyan")linear_extrude(1)for(p={sec4})p_line(p,.1);

color("blue")
linear_extrude(1){{
for(p={sec4})
intersection(){{
```

```
p_line(p,.1);
polygon({sec});
}}
p_line({sec},.1);
}}


''')
t1=time.time()
t1-t0
```

Out[139]: 0.01912832260131836

chimney-panel-support

In [140…

```
# chimney panel support
```

```
sec=corner_radius(pts1([[0,5],[0,-5,3.5],[10,0,4],[2,1,1],[34,0,4],[1,3.5]]),10)
sec1=path_offset(sec,-3)
path=bezier([[-27.5,0,3]]+ arc_3p_3d([[-27,0,3],[0,0,0],[27,0,3]],100)+[[27.5,0,3]],100)
sol=path_extrude_open(sec,path)
sol1=path_extrude_open(sec1,path[1:-1])
sec2=corner_radius(pts1([[0,0],[25,0,.5],[0,4,.5],[-1,3,.5],[-1.5,0,.5],[-2,-3,1],[-20.5,0]])
sol2=translate([0,-17,1],path_extrude_open(sec2,path[47:-47]))
sec3=corner_radius(pts1([[-6,-5,5],[12,0,5],[0,10.0001,5],[-12,0,5]]),10)
sol3=o_solid([0,0,1],sec3,5,0,0,-37)
sec4=corner_radius(pts1([[0,0],[5,0,10],[7,7,10],[14,0]]),20)
sec5=path_offset(sec4,-3)
sec6=sec4+flip(sec5)
sol4=translate([0,-25,1],path_extrude_open(sec6,path[16:30]))
sol5=translate([0,-25,1],path_extrude_open(sec6,path[-30:-16]))
sol6=translate([12,-25,2],q_rot(['x90','z-90'],linear_extrude(sec6[20:-20],39)))

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
module chimeny_support(){{
difference(){{
{swp(sol)}
{swp(sol1)}
{swp(sol3)}
}}

{swp(sol2)}

{swp(sol4)}
{swp(sol5)}

}}


difference(){{
translate([0,0,28])
rotate([0,-90,0])
chimeny_support();
//{swp(cut_plane([0,0,1],60,50,12,0,22))}
}}
//support for 3d printing the part
//translate([-15,-55,0])
//cube([25,60,2]);
//translate([0,0,27])
//rotate([0,-90,0]){{
////{swp(sol3)}
//{swp(sol6)}
//}}
''')
```

offset_3d

In [141…

```
# example of offset_3d(sec,d)
sec=corner_radius(pts1([[3,2,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),30)
sec1=o_solid([2,3,4],sec,1,10)[0]
sec2=offset_3d(sec1,-1)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")p_line3dc({sec1},.1);
color("blue")p_line3dc({sec2},.1);


''')
```

convert_3lines2fillet

In [41]:
```
# example of convert_3lines2fillet(pnt1,pnt2,pnt3,f=1.9,s=10)
t0=time.time()

sec=[[0,0],[5,0],[2.5,5]]
sol=o_solid([0,0,1],sec,1,10)
line1=sol[0]
line2=sol[1]
line3=offset_3d(line1,1)
fillet1=convert_3lines2fillet(line3,line2,line1)
fillet1=fillet1+[fillet1[0]]
# fillet1=flip(cpo(fillet1)[1:])
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")p_line3dc({line1},.05);
color("cyan")p_line3dc({line2},.05);
```

```
color("magenta")p_line3dc({line3},.05);
{swp_c(fillet1)}

''')
t1=time.time()
t1-t0
```

Out[41]: 0.007363319396972656

sunflower

In [35]:

```
# example of offset_3d when the section is not in 1 plane
# example of path_extrude2msec(sec_list, path)
t0=time.time()

t=1.1 # thickness
s=10 # number of sides of the star
d=20 # outer diameter of the star
h=50 # height of the star prism
cir1=circle(d,s=(s+1))
cir2=c3t2(q_rot([f"z{360/(s+1)/2}"],circle(d/4,s=(s+1))))
sec1=array(c2t3([cir1,cir2]))
sec1=sec1.transpose(1,0,2).reshape(-1,3)
sec1=sec1
sec1=[(sec1[i]+[0,0,1]).tolist() if i%2==0 else (sec1[i]+[0,0,t]).tolist() for i in range(len
sec1=m_points(corner_radius(sec1,20),1.1)
sol1=linear_extrude(sec1,h)

line1=corner_radius(pts1([[-20,0],[20,15,30],[20,-15]]),40)
line2=cytz(line1)
surf1=surf_extrude(line1,line2)

ip1=ip_surf(surf1,sol1)
ip2=offset_3d(ip1,-2.01)

surf4=[ip2,ip1,translate([0,0,-t],ip1),translate([0,0,-t],ip2),ip2]
avg2=array(surf4).mean(0).mean(0)

sec3=circle(5)
path3=m_points_o(corner_radius(pts1([[-4,0],[0,15,2],[3.5,4,2],[0,1]]),5),.5)
```

```
sol3=f_prism(sec3,path3)

path4=q_rot(['z90','x90'],cytz([[i,3*sin(d2r(i*20))] for i in linspace(0,20,44)]))
sol4=sol2path(sol3,path4)
v1=-array(nv(sol4[-1]))
avg1=array(sol4[-1]).mean(0)
surf4=translate(-avg2+[0,0,-.5],surf4)
surf4=sol2vector(v1,surf4,avg1)

arc1=arc_2p([0.01,0],[4.65,0],3,-1)
arc2=[q_rot([f'z{i}'],arc1) for i in arange(0,360,360/50)]
arc2p=translate([0,0,5],arc2)
arc2=array([arc2,arc2p]).transpose(1,0,2,3)

arc3=arc_2p([0.01,0],[4.65,0],3,1)
arc4=[q_rot([f'z{i}'],arc3) for i in arange(0,360,360/50)]
arc4p=translate([0,0,5],arc4)
arc4=array([arc4,arc4p]).transpose(1,0,2,3)

arc5=circle(4.5)
path5=arc_2p([0,0],[-4.5,2],10,-1)
sol5=f_prism(arc5,path5)

ip1=[ip_sol2sol(sol5,p,-1) for p in arc2]
ip2=[ip_sol2sol(sol5,p,-1) for p in arc4]

ip1=sol2vector(v1,ip1,avg1)
ip2=sol2vector(v1,ip2,avg1)
sol5=sol2vector(v1,sol5,avg1)




with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp_c(flip(surf4))}
{swp(sol4)}
//color("blue")p_line3dc({sol4[-1]},.2);
//color("magenta")p_line3d({path4},.2);

difference(){{
{swp(flip(sol5))}
for(p={ip1})p_line3d(p,.05,rec=1);
for(p={ip2})p_line3d(p,.05,rec=1);
}}

''')
t1=time.time()
t1-t0
```

Out[35]: 2.7847328186035156

sol2vector

In [42]:
```
# checking orientation of solid w.r.t. vector
t0=time.time()

sol=linear_extrude(circle(5),6)
v1=[2,3,4]
loc=[5,10,7.5]
sol1=sol2vector(v1,sol,loc)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%{swp(sol1)}
color("blue")points({[loc]},.5);
```

```
color("magenta")p_line3dc({sol[0]},.1);
color("magenta")p_line3dc({sol1[0]},.1);
color("blue")p_line3d({[[0,0,0],v1]},.1);

''')

t1=time.time()
t1-t0
```

Out[42]: 0.005764007568359375

In [145…

```
# checking orientation of solid w.r.t. vector
t0=time.time()

sec=circle(5)
v1=(array([1,1,-1])*10).tolist()
sol=o_solid(v1,sec,5,0,0,0)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%{swp(sol)}
color("blue")p_line3d({[[0,0,0],v1]},.1);


''')
```

```
t1=time.time()
t1-t0
```

Out[145]: 0.008459091186523438

In [12]:

```
# difficult fillet
t0=time.time()

sec1=circle(10,s=6)
pent1=circle(7,s=6)
pent2=c3t2(q_rot([f'z{360/5/2}'],circle(3.5,s=6)))
sec2=concatenate(cpo([pent1]+[pent2])).tolist()

sec3=oset(sec2,-1.5)
sec4=oset(sec3,1)
path1=helix(20,30,1,5)
path2=[[0,0,10],[-30,20,13]]
sol=path_extrude_open(sec2,path1)
sol1=path_extrude_open(m_points1(sec3,50),path2)
sol2=path_extrude_open(m_points1(oset(sec3,.3),50),path2)
v1=array(path2[1])-array(path2[0])
u1=v1/norm(v1)
ip1=[ip_sol2line(sol,p)[-1] for p in cpo(sol1)]
ip2=translate(u1,ip1)
ip3=[ip_sol2line(sol,p)[-1] for p in cpo(sol2)]
fillet1=convert_3lines2fillet(ip3,ip2,ip1)
fillet1=fillet1+[fillet1[0]]
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("orange"){swp(sol)}
%{swp(sol1)}
```

```
//color("blue")p_line3dc({ip1},.05);
//color("blue")p_line3dc({ip2},.05);
//color("blue")p_line3dc({ip3},.05);
color("cyan"){swp(fillet1)}

''')
t1=time.time()
t1-t0
```

Out[12]: 5.487410068511963

ip_sol2sol

In [5]:

```
# example of function ip_sol2line(sol,line)
t0=time.time()

sec=circle(10)
path=corner_radius(pts1([[-10+.1,0],[12,0],[-2,0,2],[0,10,3],[-10,0]]),5)
sol=prism(sec,path)

sol1=o_solid([1,0,1],circle(3),20,-5)

ip1=ip_sol2sol(sol,sol1,-1)
ip2=ip_sol2sol(sol,sol1,0)



with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%{swp(sol)}
```

```
%{swp(sol1)}

color("magenta")points({ip1},.3);
color("blue")points({ip2},.3);


''')
t1=time.time()
t1-t0
```

Out[5]:

```
0.08730125427246094
```

ip_sol2line

In [148…

```
# example of function ip_sol2line(sol,line)
t0=time.time()

sec=circle(10)
path=corner_radius(pts1([[-10+.1,0],[12,0],[-2,0,2],[0,10,3],[-10,0]]),5)
sol=prism(sec,path)

line=ls([[0,0,-1],[20,20,10]],10)

ip1=ip_sol2line(sol,line)[-1]
ip2=ip_sol2line(sol,line)[0]




with open('trial.scad','w+') as f:
    f.write(f'''
```

```
include<dependencies2.scad>

%{swp(sol)}

color("blue")p_line3dc({line},.05);

color("magenta")points({[ip1]},.3);
color("cyan")points({[ip2]},.3);


''')
t1=time.time()
t1-t0

ip1
```

Out[148]: [7.1354892496692255, 7.1354892496692255, 2.924519087318074]

In [149…

```
t0=time.time()

c1=l_cir_ip([[0,0],[0,5]],circle(2,[1,2.5]))
sec1=arc_long_2p(c1[0],c1[1],2,-1,50)
sol1=o_solid([0,0,1],sec1,5)

c1=l_cir_ip([[0,0],[0,5]],circle(2.3,[1,2.5]))
sec1=arc_long_2p(c1[0],c1[1],2.3,-1,50)
sol2=o_solid([0,0,1],sec1,5)

c1=l_cir_ip([[-0.3,0],[-0.3,5]],circle(2,[1,2.5]))
sec1=arc_long_2p(c1[0],c1[1],2,-1,50)
sol3=o_solid([0,0,1],sec1,5.6,-.3)
lines=array([sol1,sol3,sol2]).transpose(1,0,2,3)[1]
a,b,c=array([lines[0],lines[1],lines[2]]).tolist()
lines1=array([sol1,sol3,sol2]).transpose(1,0,2,3)[0]
h,i,j=array([lines1[0],lines1[1],lines1[2]]).tolist()
k,l,m=a+flip(h),b+flip(i),c+flip(j)
```

```
fillet1=convert_3lines2fillet(m,l,k)
fillet1=translate([0,5,0],q_rot(['z90'],fillet1+[fillet1[0]]))

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%cube(5);
%translate([1,2.5,-2.5])cylinder(r=2,h=10,$fn=100);

{swp(fillet1)}
translate([0,5,0])
rotate([0,0,90]){{
color("magenta")p_line3dc({k},.02);
color("magenta")p_line3dc({l},.02);
color("magenta")p_line3dc({m},.02);
}}
''')

t1=time.time()
t1-t0
```

Out[149]:

```
0.062006473541259766
```

In [13]:

```
t0=time.time()
sec1=circle(10,s=6)
pent1=circle(7,s=6)
pent2=c3t2(q_rot([f'z{360/5/2}'],circle(3.5,s=6)))
sec2=concatenate(cpo([pent1]+[pent2])).tolist()
sec2=corner_radius(array(c2t3(sec2))+[0,0,.5],15)
sec3=concatenate(cpo([pent1]+[pent2])).tolist()
sec3=oset(sec3,-1)
sec3=corner_radius(array(c2t3(sec3))+[0,0,.2],10)
path1=helix(20,30,1,5)
path2=[[0,0,10],[-30,20,13]]
sol=path_extrude_open(sec2,path1)
sol1=path_extrude_open(equidistant_pathc(sec3,300),path2)

sol2=sol[22:33]
sol3=slice_sol(sol1,20)
sol4=path_extrude_open(equidistant_pathc(oset(sec3,1),300),path2)
sol4=slice_sol(sol4,20)
```

```
i_p1=ip_sol2sol(sol2,sol3[12:17],0)
i_p2=i_p_p(sol3,i_p1,1)
i_p3=ip_sol2sol(sol2,sol4[12:17],0)

i_p1,i_p2,i_p3=align_sol_1([i_p1,i_p2,i_p3])

fillet1=convert_3lines2fillet_closed(i_p3,i_p2,i_p1)
# fillet1=fillet_sol2sol(sol2,sol3[12:16],1,s=20)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
//color("blue")for(p={sol3[12:16]})points(p,.1);


%{swp(sol)}
%{swp(sol3)}
//color("blue")for(p={sol4[12:16]})p_line3dc(p,.1,rec=1);
color("blue")p_line3dc({i_p1},.05,rec=1);
color("blue")p_line3dc({i_p2},.05,rec=1);
color("blue")p_line3dc({i_p3},.05,rec=1);

{swp_c(fillet1)}



''')
t1=time.time()
t1-t0
```

Out[13]: 3.521379232406616

equidistant_path

In [7]:

```
t0=time.time()
path=helix(15,20/10,10,5)
# path1=[[0,0,p[2]] for p in path]
path1=helix(0,20/10,10,5)
sec=circle(10)
path2=arc(10,-90,90,[-10+.1,10],50)
sp1=prism(sec,path2)
sol1=[path1,path]
i_p1=ip_sol2sol(sp1,sol1,0)
i_p1=equidistant_path(i_p1,500)
d=l_len([i_p1[0],i_p1[1]])
sp2=translate([0,0,10],sphere(10-d/2))
sp3=sphere(d/2)

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
    %{swp(sp2)}
    color("blue")p_line3d({i_p1},.05);
    for(p={i_p1})translate(p){swp(sp3)}

    ''')
t1=time.time()
t1-t0
```

Out[7]:

```
0.8852136135101318
```

iterative-approach-towards-creating-fillets

In [14]:

```
# iterative approach towards creating fillets

t0=time.time()
sec1=circle(10,s=6)
pent1=circle(7,s=6)
pent2=c3t2(q_rot([f'z{360/5/2}'],circle(3.5,s=6)))
sec2=concatenate(cpo([pent1]+[pent2])).tolist()
sec2=corner_radius(array(c2t3(sec2))+[0,0,.1],5)
sec3=concatenate(cpo([pent1]+[pent2])).tolist()
sec3=oset(sec3,-1)
sec3=corner_radius(array(c2t3(sec3))+[0,0,.1],5)
path1=helix(20,30,1,5)
path2=[[0,0,10],[-30,20,13]]
sol=path_extrude_open(sec2,path1)
sol1=path_extrude_open(sec3,path2)
sol2=sol[25:35]
a=array([[1-cos(d2r(i)),1-sin(d2r(i))] for i in linspace(0,90,90)])*1
b=[offset_sol(sol2,i,1) for i in a[:,0].round(2)]
c=[offset_sol(sol1,i) for i in a[:,1].round(2)]


with open('trial.scad','w+') as f:
    for i in range(len(b)):
        f.write(f'''

            intersection(){{
            {swp(b[i])}
            {swp(c[i])}
            }}


                '''
    f.write(f'''
    include<dependencies2.scad>
   color("cyan")
   {swp(sol)}
   color("blue")
   {swp(sol1)}

    ''')
t1=time.time()
t1-t0
```

Out[14]:

```
36.963170528411865
```

In [153…

```
# iterative approach for creating fillets, example-2

t0=time.time()
sec=circle(10)
path=corner_radius(pts1([[2,0],[-2,0,2],[-1,15,3],[-8,0]]),10)
sol1=q_rot(['z90'],prism(sec,path))

sec1=corner_radius(pts1([[0,0,1],[5,0,1],[0,7,2],[-5,0,2]]),10)
path1=corner_radius(pts1([[-2,0],[2,0,2],[0,5,.3],[-.5,0]]),10)
sol2=translate([6,0,12],q_rot(['x90','z90'],prism(sec1,path1)))
a=array([[1-cos(d2r(i)),1-sin(d2r(i))] for i in linspace(0,90,20)])*.75
b=[rsz3dc(sol1,array(bb(sol1))+i*2) for i in a[:,0]]
c=[rsz3dc(sol2,array(bb(sol2))+i*2) for i in a[:,1]]


with open('trial.scad','w+') as f:
    for i in range(len(a)-1):
        f.write(f'''
include<dependencies2.scad>
hull(){{
intersection(){{
{swp(b[i])}
{swp(c[i])}
}}

intersection(){{
{swp(b[i+1])}
{swp(c[i+1])}
}}
}}
```

```
''')
    f.write(f'''

    {swp(sol1)}
    {swp(sol2)}

    ''')

t1=time.time()
t1-t0
```

Out[153]: 1.4294283390045166

In [5]:

```
cyl1=linear_extrude(circle(10,s=200),30)
cyl2=translate([10,0,5],linear_extrude(circle(5,s=100),20))
# cyl2=c2ro(cyl2,1)
a=array([[1-cos(d2r(i)),1-sin(d2r(i))] for i in linspace(0,90,20)])*1
b=[rsz3dc(cyl1,array(bb(cyl1))+i*2) for i in a[:,0]]
c=[rsz3dc(cyl2,array(bb(cyl2))+i*2) for i in a[:,1]]

with open('trial.scad','w+') as f:
    for i in range(len(a)-1):
        f.write(f'''
include<dependencies2.scad>
hull(){{
intersection(){{
{swp(b[i])}
{swp(c[i])}
}}
```

```
intersection(){{
{swp(b[i+1])}
{swp(c[i+1])}
}}
}}


''')
    f.write(f'''
  {swp(cyl1)}
  {swp(cyl2)}

    ''')
```

In [5]:

```
# iterative approach to filleting example

t0=time.time()

sec=pts([[0,0],[5,0],[0,5],[-5,0]])
path=corner_radius(pts1([[-.4,0],[.4,0,0.2],[0,5,0.2],[-.4,0]]),10)
sol=prism(sec,path)

sec1=circle(1.5,s=150)
# sol1=o_solid([0,0,1],sec1,10,-1.5,0,-2.5)
sol1=o_solid([1,0,10],sec1,10,-1.5,-2.5,0)

# sol1=slice_sol(sol1,20)

a=array([[1-cos(d2r(i)),1-sin(d2r(i))] for i in linspace(0,90,20)])*.5
b=[rsz3dc(sol,array(bb(sol))+i*2) for i in a[:,0]]
c=[offset_sol(sol1,i) for i in a[:,1]]

with open('trial.scad','w+') as f:
    for i in range(len(a)-1):
        f.write(f'''
        hull(){{
intersection(){{
{swp(b[i])}
{swp(c[i])}
}}

intersection(){{
{swp(b[i+1])}
{swp(c[i+1])}
}}
}}

        ''')

    f.write(f'''
include<dependencies2.scad>

{swp(sol)}
{swp(sol1)}

''')

t1=time.time()
t1-t0
```

Out[5]:

```
0.46150994300842285
```

In [155…

```
t0=time.time()

cyl1=o_solid([0,1,0],circle(5),70,-35)
cyl2=o_solid([1,0,0],circle(5),70,-35)

a=array([[1-cos(d2r(i)),1-sin(d2r(i))] for i in linspace(0,90,20)])*1.5
b=[rsz3dc(cyl1,array(bb(cyl1))+i*2) for i in a[:,0]]
c=[rsz3dc(cyl2,array(bb(cyl2))+i*2) for i in a[:,1]]

with open('trial.scad','w+') as f:
    for i in range(len(a)-1):
        f.write(f'''
        hull(){{
intersection(){{
{swp(b[i])}
{swp(c[i])}
}}

intersection(){{
{swp(b[i+1])}
```

```
{swp(c[i+1])}
}}
}}

        ''')

    f.write(f'''
include<dependencies2.scad>

{swp(cyl1)}
{swp(cyl2)}

''')

t1=time.time()
t1-t0
```

Out[155]: 0.054795026779174805

In [156…

```
cyl1=linear_extrude(circle(5),20)
with open('trial.scad','w+') as f:
    f.write(f'''

{swp1(cyl1)}
''')
```

In [157…

```
triangle=[[0,0],[5,0],[0,5]]
p=[0,3]
tx=triangulate_4p(triangle,p)

p0,p1,p2,p3=triangle+[p]
```

```
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")points({[p0,p1,p2,p3]},.2);
//p_line({tx},.05);
for(p={tx})p_line(p,.05);
color("magenta")p_line({cir_3p(tx[0][0],tx[0][1],tx[0][2],s=72)},.05);
color("cyan")p_line({cir_3p(tx[1][0],tx[1][1],tx[1][2],s=72)},.05);


''')

tx
```

Out[157]: [[[0, 5], [0, 3], [5, 0]], [[5, 0], [0, 3], [0, 0]]]

lexicographic_sort_xy

In [158…

```
#  example of function lexicographic_sort_xy(p)
t0=time.time()
a=random.random(50)*(20-5)+5
b=random.random(50)*(30-10)+10
p=array([a.round(1),b.round(1)]).transpose(1,0)


with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
p2={lexicographic_sort_xy(p)};
color("blue")for(i=[0:len(p2)-1])translate(p2[i])text(str(i),.3);
p_lineo(p2,.05);
color("magenta")points(p2,.2);

    ''')
t1=time.time()
t1-t0
```

Out[158]: 0.00671696662902832

lexicographic_sort_yx

In [159…

```
#  example of function lexicographic_sort_yx(p)
t0=time.time()
a=random.random(50)*(20-5)+5
b=random.random(50)*(30-10)+10
p=array([a.round(1),b.round(1)]).transpose(1,0)


with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
p2={lexicographic_sort_yx(p)};
color("blue")for(i=[0:len(p2)-1])translate(p2[i])text(str(i),.3);
p_lineo(p2,.05);
color("magenta")points(p2,.2);

    ''')
```

```
t1=time.time()
t1-t0
```

Out[159]: 0.007342815399169922

convex_hull

In [14]:

```
t0=time.time()
a=random.random(1000)*(20-5)+5
b=random.random(1000)*(30-10)+10
px=array([a.round(1),b.round(1)]).transpose(1,0).tolist()
p=px
sec=[]
while(p!=[]):
    p1=convex_hull(p)
    sec.append(p1)
    p=exclude_points(p,p1)
    if p==[]:
        break
```

```
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>
points({px},.2);

color("blue")for (p={sec})p_line(p,.05);

    ''')
t1=time.time()
t1-t0
```

Out[14]: 8.780018329620361

equivalent_rot_axis

In [161…

```
# example of function equivalent_rot_axis(r1=[])
a,b,c,d,e,f1,g,h=20,-20,70,40,50,-50,70,10
r1=[ f"x{a}",f"y{b}",f"z{c}",f"y{d}",f"x{e}",f"y{f1}",f"z{g}",f"y{h}"]
sol=cylinder(h=50)
```

```
v2,theta=equivalent_rot_axis(r1)
sol1=axis_rot(v2,sol,theta)
sol2=axis_rot(v2,sol1,-theta)


with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies.scad>

// pure openscad way of rotating the 3d object
color("magenta")
rotate({[0,h,0]})
rotate({[e,f1,g]})
rotate({[0,d,0]})
rotate({[a,b,c]})
cylinder(r=1.01,h=50,$fn=30);

// rotation by function equivalent_rot_axis
r1=[ "x{a}","y{b}","z{c}","y{d}","x{e}","y{f1}","z{g}","y{h}"];

theta=equivalent_rot_axis(r1)[0];
v2=equivalent_rot_axis(r1)[1];

rotate(-theta,v2)
rotate(theta,v2)
cylinder(r=1.01,h=50,$fn=30);

    ''')
```

In [16]:
```
s_y=20+5/sin(d2r(45))
h_z=10/20*s_y
```

```
s_y1=(s_y**2-h_z**2)**0.5
sec=corner_radius(pts1([[20,s_y,5],[-20,20,5],[-20,-20,5],[20,-20,5]]),20)
sec1=oset(sec,5)

path=cr_3d([[0,0,h_z,0],[0,s_y1,-h_z,5],[0,s_y1,h_z,0]],20)

sec2=wrap_around(sec,path)
sec3=wrap_around(sec1,path)

surf1=[sec2,sec3]
surf2=surf_offset(surf1,-1)
sol=surf1+flip(surf2)+[surf1[0]]
d=s_y1/s_y*20
path2=cr_3d([[20,s_y1+.25,0,3.5],[-20,d,10,5],[-20,-d,-10,3.5],[20,-d,10,5]],20)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

//color("blue")for(p={cpo(sol)})p_line3dc(p,.05);
//color("magenta")p_line3dc({path2},.05);
{swp_c(sol)}

    ''')
```

path_extrude_open

In [16]:
```
# example of path_extrude_open(sec,path,twist=0) which adds a twist to the section
sec=pts([[0,0],[5,0],[0,1],[-5,0]])
```

```
path=cr_3d([[20,0,10,5],[-20,20,-10,5],[-20,-20,10,5],[20,-20,-10,5]],10)
# path=q_rot(['x30'],circle(20))
# path=helix(20,10,1,5.1)
sol=path_extrude_open(sec,path,1)
sol=slice_sol(sol,10)
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")p_line3d({path},.1);

{swp(sol)}


    ''')
```

tangents_along_path

normals_along_path

orthos_along_path

In [2]:

```
# path=q_rot(['x90.001'],circle(10))
# path=cr_3d([[0,0,0,3],[15,0,0,4],[5,3,15,3],[0,10,0,3],[-5,3,-15,4],[-15,0,0,3]],10)
path=cr_3d([[20,0,10,5],[-20,20,-10,5],[-20,-20,10,5],[20,-20,-10,5]],20)
# path=helix(10,5,3,5.001)

# sec=pts([[-1.5,-1.25],[3,0],[-1.5,2.5]])
# sec=pts([[0,0],[5,0],[0,1],[-5,0]])
sec=[[0,0],[1,0],[0,1]]
sol=path_extrude_open(sec,path)
# sol=slice_sol(sol,10)
```

```
# sol=align_sol(sol,1)

t_v1=tangents_along_path(path,1)
n_v1=normals_along_path(path,1)
o_v1=orthos_along_path(path,1)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

p_line3d({path},.05);
color("blue")for(p={t_v1})p_line3d(p,.05);
color("magenta")for(p={n_v1})p_line3d(p,.05);
color("cyan")for(p={o_v1})p_line3d(p,.05);

//{swp(sol)}




''')
```

In [165…

```
# sec2=[[0,0,0],[2,0,0],[0,0,2]]
sec2=[[0,1,0],[2,3,0],[0,3,2]]

cir1=cir_3p_3d(sec2,100)
cp=cp_cir_3d(sec2)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")points({sec2},.2);
p_line3dc({cir1},.05);

color("magenta")points({[cp]},.2);

''')
```

cp_cir_3d

In [18]:

```
# explanation of functions to draw circle from 3 points in 3d space
# function to get center of the circle drawn with 3 points. Note that the center of circle is
# Also note that the centroid of the triangle is same as mean of the 3 points

sec=[[0,1,0],[2,5,0],[0,2,2]] # 3 points in 3d space

cir1=cir_3p_3d(sec,50) #function to draw circle from 3 points in 3d space
cp=cp_cir_3d(sec) # function calculates the center of the circle
cp1=centroid_3p_3d(sec)
cp2=array(sec).mean(0).tolist()
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")points({sec},.2);
p_line3dc({sec},.05);

color("cyan")p_line3dc({cir1},.05);// circle drawn by 3 points input
color("violet")points({[cp]},.2);// center point of the circle containing the 3 points as inp
color("magenta")points({[cp1]},.2);// centroid of a triangle
color("black")points({[cp2]},.2);// mean is the centroid

''')
```

l_sec_ip

In [19]:
```
#  example of line to section intersection point function
line=[[1,4],[7,10]]
sec=[[0,0],[5,1],[3,7]]


i_p1=l_sec_ip(line,sec)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

p_line3dc({sec},.05);
color("cyan")p_line3dc({line},.05);
color("blue")points({i_p1},.2);


''')
```

i_line_planes

In [20]:
```
# example of intersection line between 2 planes

t0=time.time()

p1=translate([-2,0,-8.22],[[2,4,5],[7,9,15],[1,10,5]])

p2=translate([-3,0,-5],[[5,10,3],[5,-7,5],[-10,5,10]])


i_p1=i_line_planes(p2,p1)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

p_line3dc({p1},.05);
color("cyan")p_line3dc({p2},.05);
```

```
color("blue")p_line3d({i_p1},.05);


''')

t1=time.time()
t1-t0
```

Out[20]: 0.016494274139404297

surface_for_fillet

In [3]:

```
# example of function surface_for_fillet(sol1=[],sol2=[],factor1=50,factor2=10,factor3=1,fact
t0=time.time()

sec=circle(10)
path=corner_radius(pts1([[-8,0],[10,0],[-2,0,2],[-1,15,3],[-8.9,0]]),10)
path=equidistant_path(path,100)
sol1=q_rot(['z90'],prism(sec,path))

sec1=corner_radius(pts1([[0,0,1],[5,0,1],[0,7,2.3],[-5,0,2.3]]),10)
path1=corner_radius(pts1([[-2.4,0],[2.4,0,2],[0,5,.3],[-.5,0]]),10)
path1=equidistant_path(path1,30)
sol2=translate([6,0,12],q_rot(['x90','z90'],prism(sec1,path1)))

sol3=surface_for_fillet(sol1,sol2,100,20,4,23,8)
ip2=ip_sol2sol(sol2,sol3)


fillet1=i_line_fillet_closed(sol2,sol3,ip2,1,-1)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%{swp(sol1)}
%{swp(sol2)}
```

```
color("cyan")for(p={sol2})p_line3dc(p,.01,rec=1);
color("cyan")for(p={cpo(sol2)})p_line3d(p,.01,rec=1);

color("blue")for(p={sol3})p_line3dc(p,.01,rec=1);
color("blue")for(p={cpo(sol3)})p_line3d(p,.01,rec=1);
color("magenta")p_line3dc({ip2},.2,rec=1);




{swp_c(fillet1)}
color("green")for(p={fillet1})p_line3dc(p,.02,rec=1);
color("green")for(p={cpo(fillet1)})p_line3dc(p,.02,rec=1);

''')

t1=time.time()
t1-t0
```

```
C:\openscad\openscad-main\openscad1.py:4681: RuntimeWarning: invalid value encountered in div
ide
  t=einsum('kl,ijkl->ijk',cross(p01,p02),la[:,:,None]-p0)/(einsum('ijl,kl->ijk',(-lab),cross
(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4682: RuntimeWarning: divide by zero encountered in di
vide
  u=einsum('ijkl,ijkl->ijk',cross(p02[None,None,:,:],(-lab)[:,:,None,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4683: RuntimeWarning: divide by zero encountered in di
vide
  v=einsum('ijkl,ijkl->ijk',cross((-lab)[:,:,None,:],p01[None,None,:,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4683: RuntimeWarning: invalid value encountered in div
ide
  v=einsum('ijkl,ijkl->ijk',cross((-lab)[:,:,None,:],p01[None,None,:,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4684: RuntimeWarning: invalid value encountered in add
  condition=(t>=0)&(t<=1)&(u>=0)&(u<=1)&(v>=0)&(v<=1)&(u+v<1)
C:\openscad\openscad-main\openscad1.py:4681: RuntimeWarning: divide by zero encountered in di
vide
  t=einsum('kl,ijkl->ijk',cross(p01,p02),la[:,:,None]-p0)/(einsum('ijl,kl->ijk',(-lab),cross
(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4682: RuntimeWarning: invalid value encountered in div
ide
  u=einsum('ijkl,ijkl->ijk',cross(p02[None,None,:,:],(-lab)[:,:,None,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4686: RuntimeWarning: invalid value encountered in mul
tiply
  a=(la[:,None,:,None,:]+lab[:,None,:,None,:]*t[:,None,:,:,None])
```

Out[3]:

```
3.1840627193450928
```

Y
X

In [36]:

```
t0=time.time()
sec1=circle(55,s=70)
path1=corner_radius(pts1([[-50,30],[56,0],[0,8,5],[-4,3,5],[0,18,10],[8,5,10],[0,12],[-50,0]]
sol1=q_rot(['z0'],f_prism(sec1,path1))

sec2=circle(7.5)
path2=corner_radius(pts1([[-5,0],[5,0,5],[0,35,3],[-4,0]]),10)
sol2=translate([58,0,35],f_prism(sec2,path2))

surf1=surface_for_fillet(sol1,sol2,70,20,5,200,50)

fillet1=fillet_sol2sol(sol2,surf1,4)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%{swp(sol1)}
%{swp(sol2)}

color("blue")for(p={cpo(surf1)})p_line3d(p,.05);
{swp_c(fillet1)}

''')
t1=time.time()
total=t1-t0
total
```

```
C:\openscad\openscad-main\openscad1.py:2454: RuntimeWarning: invalid value encountered in arc
sin
  a=arcsin(r1/d1)*180/pi
```

Out[36]: 1.6076035499572754

i_line_fillet

In [37]:
```
i_t=time.time()
sec1=circle(55)
path1=corner_radius(pts1([[-50,0],[50,0,.2],[0,30,3],[6,1,3],[0,6,3],[-4,2,3],[0,22,6],[8,2,6
# path1=equidistant_path(path1,200)
sec2=circle(7.5)
path2=corner_radius(pts1([[-5,0],[5,0,5],[0,35,2],[-5,0]]),10)
path2=equidistant_path(path2,50)
sol1=f_prism(sec1,path1)
sol2=translate([57.5,0,37],f_prism(sec2,path2))
sol2=axis_rot_o([0,0,1],sol2,180)
p1=ip_sol2sol(sol1,cpo(sol2))
p2=ip_sol2sol(sol1,cpo(sol2),-1)

p3=flip(p1)+p2

fillet1=i_line_fillet_closed(sol1,sol2,p3,3,-3)

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

%{swp(sol1)}
%{swp(sol2)}

//color("blue")for(p={cpo(sol2)})p_line3d(p,.1,rec=1);
color("magenta")points({p1},.3);
color("magenta")points({p2},.3);
color("cyan")p_line3dc({p3},.1,rec=1);
{swp_c(fillet1)}


''')


f_t=time.time()
```

```
f_t-i_t
# len(p1),len(p2),len(p3)
```

Out[37]: 7.604323863983154

In [39]:

```
i_t=time.time()
sec=corner_radius(pts1([[-5,-5,1],[10,0,1],[0,10,1],[-10,0,1]]),10)
path=corner_radius(pts1([[-4,0],[4,0,1],[0,10,1],[-4,0]]),10)
sol1=prism(sec,path)
sol2=o_solid([1,0,.1],circle(2,s=100),15,-7,0,10,[-90,0,0])
sol2=slice_sol(sol2,2)
p1=ip_sol2sol(sol1,sol2)
p2=ip_sol2sol(sol1,sol2,-1)

p3=flip(p1)+p2
# p4=o_3d(p3,sol2,-1)
# p5=o_3d(p3,sol1,1)
# fillet1=convert_3lines2fillet_closed(p3,p5,p4)
fillet1=i_line_fillet_closed(sol1,sol2,p3,1,-1)

with open('trial.scad','w+')as f:
    f.write(f'''
    include<dependencies2.scad>

%{swp(sol1)}
%{swp(sol2)}
color("blue")p_line3d({p1},.04,rec=1);
color("magenta")p_line3d({p2},.04,rec=1);

{swp_c(fillet1)}

    ''')
f_t=time.time()
f_t-i_t
# len(p3),len(p4),len(p5)
```

Out[39]: 0.48638033866882324

In [6]:

```
i_t=time.time()

sec=pts([[0,0],[5,0],[0,5],[-5,0]])
path=corner_radius(pts1([[-2.49,0],[2.49,0,0.25],[0,5,0.25],[-2.49,0]]),10)
sol1=prism(sec,path)
v1=[2,0,8]
sec1=axis_rot([0,0,1],circle(1.5,s=100),90)
sol2=o_solid(v1,sec1,10,-1.5,-2.5,0)
p1=ip_sol2sol(sol1,sol2)
p2=ip_sol2sol(sol1,sol2,-1)

p3=flip(p1)+p2
# p4=equidistant_pathc(o_3d(p3,sol1,.5),200)
# p4=sort_points(p3,p4)
# # p4=path2path1(p3,p4)
# p5=equidistant_pathc(o_3d(p3,sol2,-.5),200)
# p5=sort_points(p3,p5)
# # p5=path2path1(p3,p5)
# p3,p4,p5=align_sol_1([p3,p4,p5])
# fillet1=convert_3lines2fillet_closed(p3,p5,p4)

fillet1=i_line_fillet_closed(sol1,sol2,p3,.5,-.5)

with open('trial.scad','w+') as f:
    f.write(f'''
```

```
include<dependencies2.scad>

%{swp(sol1)}

%{swp(sol2)}

{swp_c(fillet1)}

''')

f_t=time.time()
f_t-i_t

# len(p3),len(p4),len(p5)
```

Out[6]: 0.23434758186340332

In [214…

```
import sys
set_printoptions(threshold=sys.maxsize)
```

align_sol_1

In [174…

```
# merging 2 different shapes
t0=time.time()


sec=corner_radius(pts1([[1.5,8,.9],[2,0,.9],[0,-3,1.4],[3,0,1.4],[0,4,1.9],[-5,0,2.5],[0,6,2.
               [7,0,2.5],[0,-4,.9],[-2,0,.9],[0,3,1.4],[-3,0,1.4],[0,-4,1.9],
              [5,0,2.5],[0,-6,2.5],[-7,0,2.5]]),20)

cp1=-array(c2t3(sec)).mean(0)+[0,0,10]
sec=translate(cp1,sec)
sec1=c2t3(pts([[-5,-10],[10,0],[0,20],[-10,0]]))

sec=equidistant_pathc(sec,300)
sec1=equidistant_pathc(sec1,300)


sol=align_sol_1([sec1,sec])

sol=slice_sol(sol,30)

sol1=array(sol).reshape(-1,3)


with open('trial.scad','w+')as f:
    f.write(f'''
    include<dependencies.scad>

difference(){{
    {swp(sol)}
     translate([0,0,-.01])cube(5);
     }}

color("blue")p_line3dc({sol[-1]},.05);
    ''')

t1=time.time()
t1-t0
```

Out[174]:

```
0.2719290256500244
```

coil-example

In [175…

```
coil=array([i/360*array([cos(d2r(i)),sin(d2r(i)),-1]) for i in linspace(0,3600,720)]).tolist(
cyl1=translate([0,0,-10],cylinder(r1=10,r2=0.1,h=10))
with open('trial.scad','w+')as f:
    f.write(f'''
    include<dependencies.scad>
translate([0,0,10]){{
color("blue")p_line3d({coil},.05);
%{swp(cyl1)}
}}
    ''')
```

In [178…

```
x,y=sym.symbols('x y')

f1=sym.lambdify(x,10*sym.cos(x),'numpy')
f2=sym.lambdify(x,10*sym.sin(x),'numpy')

a=linspace(0,2*pi,100)
cir1=array([f1(a),f2(a)]).transpose(1,0).tolist()

with open('trial.scad','w+')as f:
    f.write(f'''
    include<dependencies.scad>
color("blue")p_line({cir1},.05);



    ''')
```

In [44]:

```
v1x,v1y,v2x,v2y,p0x,p0y,p1x,p1y,t1,t2=sym.symbols('v1x,v1y,v2x,v2y,p0x,p0y,p1x,p1y,t1,t2')

p0,v1=array([[2,3],[4,5]])
p1,v2=array([[10,7],[-3,7]])

# p0+v1*t1=p1+v2*t2
# v1*t1-v2*t2=p1-p0
# v1x*t1-v2x*t2=(p1-p0)x
# v1.y*t1-v2.y*t2=(p1-p0).y

sp.linsolve([v1x*t1-v2x*t2-(p1x-p0x),v1y*t1-v2y*t2-(p1y-p0y)],t1,t2)
```

Out[44]: $\displaystyle \left\{\left(\frac{- p0x v2y + p0y v2x + p1x v2y - p1y v2x}{v1x v2y - v1y v2x}, \ \frac{- p0x v1y + p0y v1x + p1x v1y - p1y v1x}{v1x v2y - v1y v2x}\right)\right\}$

In [50]:

```
# p0+v1*t1=p2+v2*t2+v3*t3
# v1*t1-v2*t2-v3*t3=p2-p0

v1x,v1y,v1z,v2x,v2y,v2z,v3x,v3y,v3z,p0x,p0y,p0z,p2x,p2y,p2z,t1,t2,t3= \
```

```
sp.symbols('v1x,v1y,v1z,v2x,v2y,v2z,v3x,v3y,v3z,p0x,p0y,p0z,p2x,p2y,p2z,t1,t2,t3')

f=sp.linsolve([v1x*t1-v2x*t2-v3x*t3-(p2x-p0x),v1y*t1-v2y*t2-v3y*t3-(p2y-p0y),v1z*t1-v2z*t2-v3
```

axis_rot_o

In [186…

```
t0=time.time()
sec=corner_radius(pts1([[-5,-5,1],[10,0,1],[0,10,1],[-10,0,1]]),10)
path=corner_radius(pts1([[-4,0],[4,0,1],[0,10,1],[-4,0]]),10)
sol1=axis_rot_o([0,1,0],prism(sec,path),90)


with open('trial.scad','w+')as f:
    f.write(f'''
    include<dependencies.scad>

%{swp_c(sol1)}
color("blue")for(p={sol1})p_line3dc(p,.1);
    ''')
t1=time.time()
t1-t0
```

Out[186]: 0.26964378356933594

In [180…

```
a=random.random(1000)*(10-1)+1
b=random.random(1000)*(10-3)+3
```

In [ ]:
```
a=random.random(1000)*(10-1)+1
b=random.random(1000)*(10-3)+3
px=array([a,b]).transpose(1,0)
p_l=array([a,b]).transpose(1,0)
p_l=p_l.tolist()
```

In [403…
```
k,n=3,10
s1=ch1(pnts,k)
py=exclude_points(pnts,s1)
pz=exclude_points(py,pies1(s1,py))

while (pz!=[] and k<=n):
    k=k+1
    s1=ch1(pnts,k)
    py=exclude_points(pnts,s1)
    x=pies1(s1,py)
    pz=exclude_points(py,x) if x!=[] else py
```

In [227…
```
# for x in arange(10):
#     for y in arange(10):
#         for z in arange(10):
#             print (x,y,z)
#             if x*y*z == 30:
#                 break
#         else:
#             continue
#         break
#     else:
#         continue
#     break
```

sphere-through-parameteric-equation

In [187…
```
# sphere through parameteric equation
t0=time.time()
s=30
cp=[0,0,0]
theta=linspace(0,180,s)
phi=linspace(0,360,s*2)
r=5
x=lambda cp,r,theta,phi :cp[0]+r*sin(d2r(theta))*cos(d2r(phi))
y=lambda cp,r,theta,phi :cp[1]+r*sin(d2r(theta))*sin(d2r(phi))
z=lambda cp,r,theta :cp[2]+r*cos(d2r(theta))

sp1=[[[x(cp,r,j,i),y(cp,r,j,i),z(cp,r,j)] for i in phi] for j in theta]


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sp1)}
''')
t1=time.time()
t1-t0
```

Out[187]:
```
0.04422783851623535
```

cone-through-parameteric-equation

In [71]:

```
# Cone through parameteric equation
t0=time.time()

x=lambda cp,r,theta: cp[0]+r*cos(d2r(theta))
y=lambda cp,r,theta: cp[1]+r*sin(d2r(theta))
z=lambda cp,r:cp[2]-r

s=50
r1,r2=5,2 #bottom and the top radius respectively
r2=r2+.00001
theta=linspace(0,360,s)
r=linspace(r1,r2,10)
h=10
cp=[0,0,h/(r1-r2)*r2+h]

cn1=[[[x(cp,i,j),y(cp,i,j),z(cp,i/(r1-r2)*h)] for j in theta] for i in r]


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(cn1)}

''')
t1=time.time()
t1-t0
```

Out[71]:

```
0.011339902877807617
```

torus-through-parameteric-equation

In [72]:

```
# Torus through parameteric equation
t0=time.time()
s=60
cp=[0,0,0]
theta=linspace(0,360,s)
phi=linspace(0,360,s*2)
R=6
r=2
x=lambda cp,r,theta,phi :cp[0]+(R+r*sin(d2r(theta)))*cos(d2r(phi))
y=lambda cp,r,theta,phi :cp[1]+(R+r*sin(d2r(theta)))*sin(d2r(phi))
z=lambda cp,r,theta :cp[2]+r*cos(d2r(theta))+.00001

sp1=[[[x(cp,r,j,i),y(cp,r,j,i),z(cp,r,j)] for j in theta] for i in phi]


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp_c(sp1)}
''')
t1=time.time()
t1-t0
```

Out[72]:

```
0.17312073707580566
```

handling-trolley

In [17]:

```
# frame
sec1=circle(12.5)
path1=c2t3(corner_radius(pts1([[0,0,5],[900,0,5],[0,600,5],[-900,0,5]]),10))

sol1=path_extrude_closed(sec1,path1)

path2=cr_3d([[600,0,0,5],[0,600,0,5],[0,0,500,5],[0,-600,0,5]],10)
sol2=align_sol_1(path_extrude_closed(sec1,path2))

sol3=translate([-100,0,0],sol2)

# hinge supports
fillet1=fillet_l_cir([[0,75],[200,75]],circle(40,[100,120]),20)[1]
fillet2=flip(fillet_l_cir([[0,75],[200,75]],circle(40,[100,120]),20)[0])
arc1=arc_long_2p(fillet1[-1],fillet2[0],40,-1)
sec2=[[0,0],[200,0],[200,75]]+fillet1+arc1+fillet2+[[0,75]]
sol4=translate([450,250,465],q_rot(['x90'],linear_extrude(sec2,20)))
sol5=translate([450,350,465],q_rot(['x90'],linear_extrude(sec2,20)))

# long arm
x1=o_solid([-1,0,0],circle(30),1800,-900,290,590,[0,0,0])
x2=o_solid([-1,0,0],circle(25),1800,-900,290,590,[0,0,0])
sol6=swp_prism_h(x1,x2)
# sol6=axis_rot_1(sol6,[0,1,0],[550,290,590],10)


# frame
sol7=o_solid([0,1,0],circle(12.5),600,0,100)
sol8=o_solid([0,1,0],circle(12.5),600,0,200)

# cylinder body
x3=o_solid([0,0,1],circle(40),300,135,150,-290)
x4=o_solid([0,0,1],circle(35),300,135,150,-290)
sol9=swp_prism_h(x3,x4)
# sol9=axis_rot_1(sol9,[0,1,0],[150,290,100],1)

# cylinder bottom cover
x5=o_solid([0,0,1],circle(40),20,135,150,-290)
# x5=axis_rot_1(x5,[0,1,0],[150,290,100],1)

# hinge of cylinder
sec1=corner_radius(pts1([[-20,-35,20],[40,0,20],[0,70],[-40,0]]))
sol10=o_solid([0,1,0],sec1,20,-10+290,150,125-20)
# sol10=axis_rot_1(sol10,[0,1,0],[150,290,100],2)
```

```
# piston
x6=o_solid([0,0,1],circle(35),20,175,150,-290)
# x6=axis_rot_1(x6,[0,1,0],[150,290,100],1)

# piston rod
x7=o_solid([0,0,1],circle(15),350,175,150,-290)
# x7=axis_rot_1(x7,[0,1,0],[150,290,100],1)

# cylinder top cover
x8=o_solid([0,0,1],circle(40),20,425,150,-290)
# x8=axis_rot_1(x8,[0,1,0],[150,290,100],1)


# c-clamp for hinge support
sec1=corner_radius(pts1([[-20,0,20],[40,0,20],[0,260,20],[-40,0,20]]),10)
sec1=equidistant_pathc(sec1,300)
sec2=oset(sec1,-19)

path1=corner_radius(pts1([[0,100],[0,-100,10],[70,0,10],[0,120]]),10)
path1=equidistant_path(path1,300)
path1=translate([0,0,0],q_rot(['x90','z90'],path1))
fold1=wrap_around(sec1,path1)

fold2=wrap_around(sec2,path1)
surf1=[fold1]+[fold2]
surf2=surf_offset(surf1,-5)
sol11=[surf1[1]]+[surf1[0]]+[surf2[0]]+[surf2[1]]
sol11=translate([150,255,520],sol11)
# sol11=axis_rot_1(sol11,[0,1,0],[550,290,590],10)
# sol11=axis_rot_1(sol11,[0,1,0],[170,290,670],-9)

# c-clamp for counterweight
x9=[surf1[1]]+[surf1[0]]+[surf2[0]]+[surf2[1]]
x9=translate([850,255,520],x9)

# catcher
arc1=c2t3(arc(200,-90,90,s=100))

sol12=path_extrude_open(circle(10),arc1)
sol12=translate([-1090,290,590],sol12)
# sol12=axis_rot_1(sol12,[0,1,0],[550,290,590],10)

# hinge pin c-clamp
sol13=o_solid([0,1,0],circle(5),100,240,150,590)
# sol13=axis_rot_1(sol13,[0,1,0],[550,290,590],10)

# hinge pin cylinder mounting
sol14=o_solid([0,1,0],circle(5),100,240,150,90)

# hinge pin long arm
sol15=o_solid([0,1,0],circle(5),140,220,550,590)

# hinge pin counterweight
x10=o_solid([0,1,0],circle(5),100,240,850,590)


# rod for counterweight
x11=o_solid([0,0,1],circle(15),300,225,850,-290)

# counterweight
s1=corner_radius(pts1([[100,20],[-120,0,19],[0,-40,19],[120,0]]),10)+arc_long_2p([100,-20],[1

x12=o_solid([0,0,1],s1,100,235,850,-290,[90,0,0])

# support for counterweight
x13=o_solid([0,0,1],circle(100),10,225,850,-290)

# trolley wheel
```

```python
s1=circle(15)
p1=q_rot(['x90'],circle(50))
wh=path_extrude_closed(s1,p1)
wh=align_sol_1(wh)
s2=circle(4)
p2=[[-50,0,0],[50,0,0]]
spk=[axis_rot([0,1,0],path_extrude_open(s2,p2),i) for i in linspace(0,360,6)[:-1]]



with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
// frame
swp_c({sol1});
swp_c({sol2});
swp_c({sol3});
swp({sol7});
swp({sol8});

// hinge supports
swp({sol4});
swp({sol5});

for(i=[20,80])
translate([-400,i,-500])
swp({sol4});
swp_c({sol6});

//cylinder body
sol9={sol9};
%swp_c(sol9);
//cylinder bottom cover
x5={x5};
swp(x5);

//hinge for cylinder
swp({sol10});

//piston
x6={x6};
swp(x6);


color("cyan")
union(){{
//piston rod
x7={x7};
swp(x7);

//cylinder top cover
x8={x8};
swp(x8);
}}

// c-clamp for pivot point hinge support
sol11={sol11};
swp(sol11);

// catcher
sol12={sol12};
swp(sol12);

//hinge pin
sol13={sol13};
color("cyan")swp(sol13);

//hinge pin cylinder
sol14={sol14};
```

```
color("cyan")swp(sol14);


//hinge pin long arm
sol15={sol15};
color("cyan")swp(sol15);

//c-clamp for counterweight
x9={x9};
swp(x9);

// hinge pin counterweight
x10={x10};
color("cyan")swp(x10);

// rod for counterweight
x11={x11};
color("cyan")swp(x11);

//counterweight
x12={x12};
swp(x12);

//counterweight
x13={x13};
color("cyan")swp(x13);

//trolley wheels
for(j=[0,900])
for(i=[-30,630])
translate([j,i,0]){{
swp_c({wh});
for(p={spk})swp(p);
}}
''')
```

r_sec

In [189…

```
# example of function r_sec(r1,r2,cp1,cp2)

t0=time.time()


line=[[1,2],[5,-6]]
r1,r2=5,1

sec1=r_sec(r1,r2,line[0],line[1])

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line3dc({sec1},.1);
color("magenta")p_line3d({line},.1);
color("cyan")points({line},.2);

''')
t1=time.time()
t1-t0
```

Out[189]:

```
0.004086017608642578
```

3d-knots

In [18]:
```
# 3d knots various types
t0=time.time()
# trefoil knot

path=[[10*(sin(t)+2*sin(2*t)),
      10*(cos(t)-2*cos(2*t)),
      -10*sin(3*t)] for t in d2r(arange(0,360))]

# circular sin theta knot

# path=[[60*(cos(t)),
#       60*(sin(t)),
#       20*sin(4*t)*cos(4*t)] for t in d2r(arange(0,360))]

# random knot

# path=[[20*(-0.22*cos(t) - 1.28*sin(t) - 0.44*cos(3*t) - 0.78*sin(3*t)),
# 20*(-0.1*cos(2*t) - 0.27*sin(2*t) + 0.38*cos(4*t) + 0.46*sin(4*t)),
# 20*(0.7*cos(3*t) - 0.4*sin(3*t))] for t in d2r(arange(0,360))]

# torus knots

# path=[[10*cos(3*t)*(3+cos(4*t)),
# 10*sin(3*t)*(3+cos(4*t)),
# 10*sin(4*t)] for t in d2r(arange(0,360))]

# cinquefoil torus knots
a,p,q=3,11,12
d=10

# explanation
# radius of the torus = a*d
# section radius of the torus = d
# p in number of cycles of the wrapping coil over torus
# q in the number of turns of the wrapping coil over torus

path=[[d*cos(p*t)*(a+cos(q*t)),
d*sin(p*t)*(a+cos(q*t)),
-d*sin(q*t)] for t in d2r(arange(0,360,.25))]



# Lissajous knots

# path=[[10*cos(3*t+5),
# 10*cos(3*t+10),
# 10*cos(3*t+2)]for t in d2r(arange(0,360))]
r=2
sec=circle(r)
sol=align_sol_1(path_extrude_closed(sec,path))

sec1=circle(d-r)
path1=c2t3(circle(a*d))
sol1=path_extrude_closed(sec1,path1)

# sol2=o_solid([0,0,-1],circle(38),2,10)
# sol3=o_solid([0,0,-1],circle(20),2,10)
# sol2=swp_prism_h(sol2,sol3)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
difference(){{
```

```
{swp(sol)}
//{swp(cut_plane([0,-1,0],[100,100],100))}
}}

''')
t1=time.time()
t1-t0
```

Out[18]: 3.011662006378174

0
20
20
40

-40
-20
0
20
40
60

-40
-20
0
20
40

In [179…

```
# sinwave
length=200
starting_point=-100
number_of_waves=10
amplitude=5
a=[[r2d(i)/360*length+starting_point,amplitude*sin(number_of_waves*i)] for i in d2r(arange(0,

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line3d({a},1);


''')
```

glass-model

In [5]:

```
# glass model
r=15
a1=1/20 #taper of the glass
h1=20
h2=20
s1=10
cir1=circle(r,s=s1+1)
path1=corner_radius(pts1([[-1,0],[1,0,1],[a1*h1,h1]]),10)
sol1=prism(cir1,path1)
sol1=align_sol_1([equidistant_pathc(p,200) for p in sol1])
sol1=slice_sol(sol1,30)

cir2=circle((r+a1*h1)/cos(d2r(360/(s1+1)/4)),s=201)
path2=corner_radius(pts1([[0,h1+.25],[a1*h2,h2,.49],[-1,0,.49],[-a1*h2,-h2,.5],[-.5,-.5,.5],[
sol2=prism(cir2,path2)
sol3=sol1+sol2
p0=sol1[-1]
p1=sol2[0]
p2=sol1[-2]
fill=convert_3lines2fillet(p2,p1,p0,s=30)
fill=fill+[fill[0]]
sec=square(100,center=True)
cut1=o_solid([0,-1,0],sec,100,theta=[0,0,10])
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
difference(){{
union(){{
{swp(sol3)}
{swp_c(fill)}
}}

{swp(cut1)}

}}
''')
```

q(vector=[1,0,0],point=[0,5,0],theta=0)

In [2]:
```
q(vector=[1,0,0],point=[0,5,0],theta=90)
```

Out[2]:
```
[0.0, 8.881784197001252e-16, 5.0]
```

q_rot

In [10]:
```
line=[[0,0,0],[10,0,0]]
line1=q_rot(['z30','x90'],line)

pnt=[20,0]
pnt1=q_rot(['z45'],pnt)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
```

```
p_line3d({line},1);
color("blue")p_line3d({line1},1);
color("magenta")points({[pnt]},1);
color("magenta")points({[pnt1]},1);

''')
```

ang(x,y)

In [196…

```
# example of function ang(x,y)
pnt=[20,0]
pnt1=q_rot(['z125'],pnt)
ang(pnt1[0],pnt1[1])
```

Out[196]:

```
125.0
```

l_len

In [197…

```
l_len([[0,0,0],[10,0,0]])
```

Out[197]:

```
10.0
```

l_lenv

In [198…

```
l_lenv([[0,0,0],[10,0,0],[10,5,0],[0,5,0]])
```

Out[198]:

```
30.0
```

l_lenv_o

In [199…

```
l_lenv_o([[0,0,0],[10,0,0],[10,5,0],[0,5,0]])
```

Out[199]:

```
25.0
```

arc

In [200…

```
arc1=arc(radius=5,start_angle=0,end_angle=120,cp=[0,0],s=30)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>


color("blue")p_lineo({arc1},.1);
''')
```

pts

In [201…

```
# calculates the cumulative sum of points
pts([[0,0],[4,0],[2,3],[5,-8]])
```

Out[201]:

```
[[0, 0], [4, 0], [6, 3], [11, -5]]
```

axis_rot_1

In [11]:

```
sol=o_solid([1,0,0],circle(5),100)
sol1=axis_rot_1(sol,[0,1,0],[80,0,0],15)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%{swp(sol)}
{swp(sol1)}
''')
```

arc_2p_3d

arc_2p_3p_cp

In [9]:

```
'''
    draws an arc through 2 points
    n1: normal vector to define plane on which the arc will be drawn
    r: radius of the arc
    cw: '1' stands for clockwise and '-1'stands for counter-clockwise
    's' is the number of segments of the circle
    '''

p0=[5,0,0]
p1=[2,4,2]
p2=[0,0,0]
n1=nv([p0,p1,p2])
n2=(array(n1)*3).tolist()
arc1=arc_2p_3d(n1,p0,p1,3,-1)
cp=arc_2p_3d_cp(n1,p0,p1,3,-1)
n_line=[cp,(array(cp)+array(n2)).tolist()]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line3d({arc1},.1);
color("magenta")p_line3dc({n_line},.1);
color("cyan")points({[p0,p1]},.5);

''')
n1
```

Out[9]:

```
[0.0, 0.4472135954999579, -0.8944271909999159]
```

c2t3

In [10]:
```
# function to convert 2d to 3d, it just adds the z-coordinate to the points list
#     example:
list=c2t3([[1,2],[3,4],[6,7]])
list
```

Out[10]:
```
[[1, 2, 0], [3, 4, 0], [6, 7, 0]]
```

c3t2

In [187…
```
# function to convert 3d to 2d, it just removes the z-coordinate from the points list
#     example:
list=c3t2([[1,2,3],[3,4,5],[6,7,8]])
list
```

Out[187]:
```
[[1, 2], [3, 4], [6, 7]]
```

nv

In [188…

```
# given 3 points ['p1','p2',p3] function calculates unit normal vector
#     example:
p1,p2,p3=[1,0,0],[0,10,0],[-5,0,0]
nv([p1,p2,p3]) #=> [0.0, 0.0, -1.0]
```

Out[188]:

```
[0.0, 0.0, -1.0]
```

cytz

In [189…

```
#     function to convert the y co-ordinates to z co-ordinates e.g.[x,y]=>[x,0,y]. 2d to 3d c
list=cytz([[1,2],[3,4],[6,7]])
list
```

Out[189]:

```
[[1, 0, 2], [3, 0, 4], [6, 0, 7]]
```

d2r

In [190…

```
# function to convert from degrees to radians
d2r(90)
```

Out[190]:

```
1.5707963267948966
```

r2d

In [191…

```
# function to convert from radians to degrees
r2d(1.57079)
```

Out[191]:

```
89.99963750135457
```

flip

In [11]:

```
# function to flip the sequence of a list or a list of points
#     example:
list=[1,2,3,4,5]
flipped_list1=flip(list) #=> [5, 4, 3, 2, 1]

list=[[1,2,3],[4,5,6],[7,8,9]]
flipped_list2=flip(list) #=> [[7, 8, 9], [4, 5, 6], [1, 2, 3]]
flipped_list1, flipped_list2
```

Out[11]:

```
([5, 4, 3, 2, 1], [[7, 8, 9], [4, 5, 6], [1, 2, 3]])
```

gcd

In [212…

```
# calculates the greatest common divisor of 2 numbers 'a','b'
gcd(12,15)
```

Out[212]:

```
3
```

lcm

In [213…

```
# calculates the least common multiple of 2 numbers 'a','b'
lcm(12,15)
```

Out[213]:

```
60.0
```

list_r

In [18]:

```
#     function list the corner radiuses of a given section (only where the radius is specifie
#     example:
sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1.25],[-8,0,2],[-5,20,1.4]]),5)
r1=list_r(sec)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
sec={sec};
r1={r1.tolist()};
color("blue")p_line({sec},.05);
color("magenta")points({sec},.2);
color("black")for(i=[0:len(sec)-1])translate({oset(sec,.5)}[i])text(str(r1[i]),.25);

''')
r1
```

Out[18]:

```
array([0.  , 1.  , 1.  , 1.  , 1.  , 0.  , 0.  , 3.  , 3.  , 3.  , 3.  ,
       0.  , 0.  , 1.25, 1.25, 1.25, 1.25, 0.  , 0.  , 2.  , 2.  , 2.  ,
       2.  , 0.  , 0.  , 1.4 , 1.4 , 1.4 , 1.4 , 0.  ])
```

ls(line,n)

In [194…

```
# function to draw number of points 'n' in a line 'line'
#     example:
line=[[0,0],[10,0]]
line1=ls(line,5) #=> [[0.0, 0.0], [2.0, 0.0], [4.0, 0.0], [6.0, 0.0], [8.0, 0.0], [10.0, 0.0]
line1
```

Out[194]:

```
[[0.0, 0.0], [2.0, 0.0], [4.0, 0.0], [6.0, 0.0], [8.0, 0.0]]
```

max_r(sec)

In [195…

```
# function calculates the maximum radius in a given closed section
#     example:
sec=cr_c(pts1([[0,0,.2],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
max_r(sec) #=> 3.0
```

Out[195]:

```
3.0
```

arc_long_2p_3d

In [14]:

```
# draws a long arc through 2 points
#     n1: normal vector to define plane on which the arc will be drawn
#     r: radius of the arc
#     cw: '1' stands for clockwise and '-1'stands for counter-clockwise
#     's' is the number of segments of the circle

p0=[5,0,0]
p1=[2,4,2]
p2=[0,0,0]
n1=nv([p0,p1,p2])
n2=(array(n1)*3).tolist()
arc1=arc_long_2p_3d(n1,p0,p1,10,-1)

cp=arc_2p_3d_cp(n1,p0,p1,10,1)
n_line=[cp,(array(cp)+array(n2)).tolist()]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line3d({arc1},.1);
color("magenta")p_line3dc({n_line},.2);
color("cyan")points({[p0,p1]},.5);

''')
```

In [41]:

```
t0=time.time()

sec=pts([[0,0],[5,0],[0,5],[-5,0]])
path=corner_radius(pts1([[-2.5,0],[2.5,0,0.25],[0,5.01,0.25],[-2.5,0]]),10)
sol=f_prism(sec,path)

v1=[2,0,7]
sec1=axis_rot([0,0,1],circle(1.5,s=100),90)
```

```
sol1=o_solid(v1,sec1,10,-1.5,-2.5,0)
sol2=[ip_sol2line(sol,p)[0] if ip_sol2line(sol,p)!=[] else p[1] for p in cpo(sol1) ]

sol2=translate([.01,0,0.01],[sol1[0]]+[sol2])
fillet1=fillet_sol2sol(sol,sol2,.3,o=1)[:-2]
fillet1=flip(fillet1)

sol3=[ip_sol2line(sol,p)[0] if ip_sol2line(sol,p)!=[] else p[1] for p in cpo(flip(sol1))]
sol3=[flip(sol1)[0]]+[sol3]
sol3=translate([0.01,0,-.01],sol3)
fillet2=fillet_sol2sol(sol,sol3,.3)[1:-2]

fillet3=fillet1+fillet2+[fillet1[0]]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sol)}
{swp(sol1)}
{swp_c(fillet3)}
//{swp_c(fillet2)}
//color("blue")p_line3dc({fillet1[0]},.05);
//color("blue")p_line3dc({fillet2[0]},.05);


''')
t1=time.time()
t1-t0
```

Out[41]:

```
0.5353126525878906
```

ang_2lineccw

In [16]:

```
p0=[0,0]
p1=[5,2]
p2=[7,8]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

// case 1: counter-clockwise angle between line p1p0 and p1p2 is 229.76 degrees
color("blue")points({[p0,p1,p2]},.2);
color("cyan")p_line3d({[p0,p1,p2]},.1);
color("magenta")translate([0,-.5]){{
translate({p0})text("p0",.5);
translate({p1})text("p1",.5);
translate({p2})text("p2",.5);
}}

// case 2: counter-clockwise angle between line p0p1 and p0p2 is 27.01 degrees

translate([10,0,0]){{
color("blue")points({[p0,p1,p2]},.2);
color("cyan")p_line3d({[p1,p0,p2]},.1);

color("magenta")translate([0,-.5]){{
translate({p0})text("p0",.5);
translate({p1})text("p1",.5);
translate({p2})text("p2",.5);
}}
}}

''')
ang_2lineccw(p1,p0,p2),ang_2lineccw(p0,p1,p2)
```

Out[16]: (229.76364169072616, 27.012665347938547)

ang_2linecw

In [17]:
```
p0=[0,0]
p1=[5,2]
p2=[7,8]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

// case 1: clockwise angle between line p1p0 and p1p2 is 130.23 degrees
color("blue")points({[p0,p1,p2]},.2);
color("cyan")p_line3d({[p0,p1,p2]},.1);
color("magenta")translate([0,-.5]){{
translate({p0})text("p0",.5);
translate({p1})text("p1",.5);
translate({p2})text("p2",.5);
}}

// case 2: clockwise angle between line p0p1 and p0p2 is 332.98 degrees

translate([10,0,0]){{
color("blue")points({[p0,p1,p2]},.2);
color("cyan")p_line3d({[p1,p0,p2]},.1);

color("magenta")translate([0,-.5]){{
translate({p0})text("p0",.5);
translate({p1})text("p1",.5);
translate({p2})text("p2",.5);
}}
}}

''')
ang_2linecw(p1,p0,p2),ang_2linecw(p0,p1,p2)
```

Out[17]: (130.23635830927384, 332.98733465206146)

cir_2p

cp_arc

In [18]:
```
p1=[5,2]
p2=[7,8]
r=10
c1=cir_2p(p1,p2,r,cw=-1,s=50)
cp1=cp_arc(c1)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("cyan")points({[p1,p2]},.5);
color("blue")p_line3dc({c1},.1);
color("magenta")points({[cp1]},.5);


''')
```

circle

In [201…

```
c1=circle(r=10,cp=[0,0],s=50)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")p_line3dc({c1},.1);


''')
```

CW

In [202…

```
sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
cw(sec)
```

Out[202]:

```
-1
```

CWV

In [203…

```
sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
cwv(sec)
```

Out[203]:
```
[-1,
 -1,
 -1,
 -
```

```
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1,
 -1]
```

exclude_points

In [204…

```
p0=[[ 0,  1,  2],[ 3,  4,  5],[ 6,  7,  8],[ 9, 10, 11],[12, 13, 14],[15, 16, 17],
[18, 19, 20], [21, 22, 23],[24, 25, 26], [27, 28, 29]]

p1=[[0,1,2],[9,10,11]]

p2=exclude_points(p0,p1)
p2
```

Out[204]:

```
[[3, 4, 5],
 [6, 7, 8],
 [12, 13, 14],
 [15, 16, 17],
 [18, 19, 20],
 [21, 22, 23],
 [24, 25, 26],
 [27, 28, 29]]
```

intersections

In [19]:

```
sec=corner_radius(pts1([[0,0,1],[8,3,3],[5,7,1],[-8,0,2],[-5,20,1]]),20)
sec=sec=corner_radius(pts1([[0,0,.1],[7,5,2],[5,7,2],[-5,7,2],[-7,5,3]]),20)
sec=corner_radius(pts1([[-15,0,2.49],[0,15,3],[30,0,3],[0,-15,2.49],[5,0,2.49],[0,20,7],[-40,
# sec=circle(10)
# sec=pts([[0,0],[10,0],[0,10],[-10,0]])

offset_line_segments=offset_segv(sec,-2.5)
```

```
intersection_points=intersections(offset_line_segments)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_line({sec},.1);
color("cyan")for(p={offset_line_segments})p_line(p,.1);
color("magenta")points({intersection_points},.2);


''')
```

In [20]:

```
c1=c2t3(circle(10))
c2=translate([0,0,10],circle(5,s=70))

c3=path2path1_closed(c2,c1)
```

```
sol=cpo(align_sol_1([c3,c2]))

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")points({c2},.2);
color("cyan")points({c3},.2);
color("green")points({c1},.2);
color("magenta")points({circle(10,s=70)},.3);

color("magenta")for(p={sol})p_line3d(p,.05,rec=1);



''')
```

sol2path

In [22]:

```
#  example to extrude a solid along a path

# profile of the fan blade
t0=time.time()

p0=corner_radius(pts1([[0,0,.5],[20,-2,300],[20,-5,5],[5,5,4],[-5,5,5],[-20,0,300],[-20,-2,.5

# blade profile smoothened with bezier
# sec=bezier(p0,300)
sec=equidistant_pathc(p0,300)

sol=linear_extrude(sec,45)
```

```
sol1=translate([45,0,0],q_rot(['y-90'],sol))
sol1=c2ro(sol1,1)
# zval=[p[0][2] for p in sol1]
# sol1=c3t2(sol1)

# generating helical path to extrude the profile
arc1=c2t3(arc(30,-10,0,s=2))
path=arc1+helix(30,120,.25,5)[3:]
path=bezier(path,100)


# code to extrude the solid along the given path
sol2=sol2path(sol1,path)
sol2=slice_sol(sol2,5)

# file path needs to be modified
with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
difference(){{
union(){{
for(i=[0:360/3:359])
rotate([0,0,i])
mirror([0,1,0]){swp(sol2)}
}}

//{swp(cut_plane([0,0,1],[1000,1000],100,20))}
}}

color("blue")p_line3d({path},1,1);
''')
t1=time.time()
t1-t0
```

Out[22]:

```
0.29431748390197754
```

In [4]:

```
# profile of the fan blade
t0=time.time()

p0=corner_radius(pts1([[0,0,.5],[20,-2,300],[20,-5,5],[5,5,4],[-5,5,5],[-20,0,300],[-20,-2,.5
```

```python
# blade profile smoothened with bezier
# sec=bezier(p0,200)
sec=equidistant_pathc(p0,300)

sol=linear_extrude(sec,45)
sol1=translate([45,0,0],q_rot(['y-90'],sol))
sol1=c2ro(sol1,1)
zval=[p[0][2] for p in sol1]
solx=c3t2(sol1)

sol2=[]
for p in solx:
    r1=array([l_len(p1) for p1 in seg(p) ]).min()/5
    s1=corner_radius([[p[0][0],p[0][1],r1],[p[1][0],p[1][1],r1],[p[2][0],p[2][1],r1],[p[3][0]
    sol2.append(s1)

sol2=[translate([0,0,zval[i]],sol2[i]) for i in range(len(sol2))]

# generating helical path to extrude the profile
arc1=c2t3(arc(30,-10,0,s=3)[:-1])
path=arc1+helix(30,120,.25,5)
path=bezier(pa2pb(path,zval),len(zval))


# extrude a solid to a different path


sol3=sol2path(sol2,path)
sol3=slice_sol(sol3,5)


with open('trial.scad','w+') as f:
    f.write(f'''
difference(){{
union(){{
for(i=[0:360/3:359])
rotate([0,0,i])
mirror([0,1,0]){swp(sol3)}
}}

//{swp(cut_plane([0,0,1],[1000,1000],100,20))}
}}
''')
t1=time.time()
t1-t0
```

Out[4]: 2.589282751083374

In [24]:

```
t0=time.time()

sec=circle(5)
path1=corner_radius(pts1([[-3,0],[3,0,3],[0,15,2],[-2,5,3],[2,5,2],[0,20,3],[-3,0]]),10)
path1=equidistant_path(path1,200)
sol=prism(sec,path1)
path=bspline_cubic(cr_3d([[10,0,0,0],[10,15,10,8],[0,0,15,6],[20,0,0,0]],20))
sol2=sol2path(sol,path)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%{swp(sol)}
%{swp(sol2)}
color("cyan")p_line3d({path},.5);
''')

t1=time.time()
t1-t0
```

Out[24]:

```
1.9099178314208984
```

In [25]:

```
sec=circle(5)
path=bezier(pts([[5,0],[15,10],[-26,10],[0,10],[5,6],[5,15],[4,4]]),50)
path1=q_rot(['x90'],corner_radius(pts1([[0,0],[0,45,15],[30,0]]),10))
sol=prism(sec,path)
sol1=sol2path(sol,path1)
```

```
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")p_line3d({path1},1);
{swp(sol1)}
    ''')
```

rounding-various-rounded-cubes

In [26]:

```
t0=time.time()
r=1
sec=corner_radius(pts1([[0,0,r],[20,0,r],[0,10,r],[-10,0,r],[0,10,r],[-10,0,r]]),10)
path=corner_radius(pts1([[-r,0],[r,0,r],[0,10,r],[-r,0]]),10)
sol=prism(sec,path)

sec1=corner_radius(pts1([[0,0,r],[10,0,r],[0,10,r],[-10,0,r]]),10)
path1=corner_radius(pts1([[-r,10],[r,0,r],[0,10,r],[-r,0]]),10)
sol1=prism(sec1,path1)
l1=cr_3d([[10-r,0,10-r,0],[r,0,r,r],[0,10,0,r],[-r,0,-r,0]],10)
l2=cr_3d([[10-r,0,10+r,0],[r,0,0,r],[0,10,0,r],[-r,0,0,0]],10)
l3=cr_3d([[10+r,0,10-r,0],[0,0,r,r],[0,10,0,r],[0,0,-r,0]],10)
fillet1=convert_3lines2fillet(l3,l2,l1)

l1=cr_3d([[10,10-r,10-r,0],[0,r,r,r],[-10,0,0,r],[0,-r,-r,0]],10)
l2=cr_3d([[10,10-r,10+r,0],[0,r,0,r],[-10,0,0,r],[0,-r,0,0]],10)
l3=cr_3d([[10,10+r,10-r,0],[0,0,r,r],[-10,0,0,r],[0,0,-r,0]],10)
fillet2=convert_3lines2fillet(l3,l2,l1)

l1=cr_3d([[0+r,10-r,10,0],[0,-10+2*r,0,.2],[10-2*r,0,0,0]],10)
l2=cr_3d([[0,10-r,10+r,0],[0,-10+r,0,r],[10-r,0,0,0]],10)
l3=cr_3d([[0,10-r,10-r,0],[0,-10+r,0,r],[10-r,0,0,0]],10)
sol2=array([l1,l2,l3]).transpose(1,0,2).tolist()

l1=cr_3d([[10-r,10,10+r,0],[r,0,0,r],[0,-r,0,0],[0,0,-r,r-.05],[r,0,0,0],[0,r,0,r],[0,0,-r,0]


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%{swp(sol)}
%{swp(sol1)}

//color("blue")points({l1},.1);
//color("blue")points({l2},.1);
//color("blue")points({l3},.1);

{swp(fillet1)}
{swp(fillet2)}
{swp(sol2)}


''')
t1=time.time()
t1-t0
```

Out[26]:

```
0.33608102798461914
```

ip_triangle

In [7]:
```
t0=time.time()

sec=pts([[0,0],[5,0],[0,5],[-5,0]])
sec=equidistant_pathc(sec,50)
path=corner_radius(pts1([[-2.49,0],[2.49,0,0.25],[0,5,0.25],[-2.49,0]]),10)
sol1=prism(sec,path)
v1=[2,0,8]
sec1=axis_rot([0,0,1],circle(1.5,s=100),90)
sol2=o_solid(v1,sec1,10,-1.5,-2.5,0)
p1=ip_sol2sol(sol1,sol2)
p2=ip_sol2sol(sol1,sol2,-1)

p3=flip(p1)+p2


tri_1=ip_triangle(p3,sol1)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%{swp(sol1)}

//%{swp(sol2)}

color("magenta")points({p3},.05);
```

```
color("blue")for(p={tri_1})p_line3dc(p,.04,rec=1);
''')
t1=time.time()
t1-t0
```

Out[7]: 0.3002438545227051

p0 + v0*t0* = *pa* + *v1*t1 + v2*t2

v0*t0*-*v1*t1-v2*t2 = pa-p0

[v0, -v1, -v2] *[t0 , t1 , t2] = [pa-p0]

In [28]:

```
sec=pts([[0,0],[5,0],[0,5],[-5,0]])
path=corner_radius(pts1([[-2.4,0],[2.4,0,0.25],[0,5,0.25],[-2.4,0]]),10)
sol1=prism(sec,path)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")for(p={cpo(sol1)})p_line3dc(p,.01,rec=1);
color("cyan")for(p={cpo(sol1)})polyhedron(p,[{arange(len(cpo(sol1)[0])).tolist()}]);
```

```
''')
```

bspline_cubic

In [29]:

```
p0=pts2([[0,0,0],[10,-2,2],[0,10,3],[5,-3,-6],[-5,5,1],[0,7,-2],[0,0,5]])


c1=bezier(p0,100)

s1=bspline_cubic(p0,20)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")points({p0},.5);

color("cyan")p_line3d({c1},.05,rec=1);

color("green")p_line3d({s1},.05,rec=1);



''')


(len(p0)-2)*20,len(s1)
```

Out[29]:

```
(100, 100)
```

In [30]:

```
px=pts2([[0,0,0],[5,2,3],[5,8,5],[-15,-3,-2],[0,10,0],[7,0,6],[-3,5,-4]])

b=bspline_cubic(px)
c=bezier(px,100)

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
color("blue")points({px},.5);
color("magenta")p_line3d({b},.1);
color("cyan")p_line3d({c},.1);


''')

len(b)
```

Out[30]:

```
50
```

In [31]:
```
px=pts2([[0,0,0],[5,2,3],[5,8,5],[-15,-3,-2],[0,10,0],[7,0,6],[-3,5,-4]])
px=helix(10,5,1,5)
b=bspline_cubic(px)
c=bezier(px,100)

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
color("blue")points({px},.5);
color("magenta")p_line3d({b},.1,rec=1);
color("cyan")p_line3d({c},.1,rec=1);


''')

len(b)
```

Out[31]:
```
700
```

faces

In [32]:
```
sec=pts([[0,0],[5,0],[0,5],[-5,0]])
# sec=equidistant_pathc(sec,50)
path=corner_radius(pts1([[-1,0],[1,0,0.25],[0,5,0.25],[-1,0]]),10)
sol1=prism(sec,path)
l,m,_=array(sol1).shape
v=array(sol1).reshape(-1,3).tolist()
f1=faces(l,m)

with open('trial.scad','w+') as f:
```

```
    f.write(f'''
include<dependencies2.scad>

polyhedron({v},{f1});

''')
```

faces_1

In [33]:
```
sec=pts([[0,0],[5,0],[0,5],[-5,0]])
# sec=equidistant_pathc(sec,50)
path=corner_radius(pts1([[-1,0],[1,0,0.25],[0,5,0.25],[-1,0]]),10)
sol1=prism(sec,path)
l,m,_=array(sol1).shape
v=array(sol1).reshape(-1,3).tolist()
f1=faces_1(l,m)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

polyhedron({v},{f1});

''')
```

In [34]:
```
p0=[10,0,0]
p1=[5,2,3]
p2=[10,1,1]

l1,p2=array([p0,p1]),array(p2)

v1=l1[1]-l1[0]
u1=v1/norm(v1)
v2=p2-l1[0]

v2sint=norm(cross(v1,v2))/norm(v1)
v2cost=(v1@v2)/norm(v1)
t1=v2cost/norm(v1)
p3=l1[0]+v1*t1
p2=p2.tolist()
p3=p3.tolist()

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

color("blue")points({[p0,p1,p2,p3]},.3);
color("cyan")p_line3d({[p0,p1]},.1);
color("magenta")p_line3d({[p2,p3]},.1);



''')
t1
```

Out[34]:
```
0.13157894736842107
```

p2p_intersection_line

l_sec_ip_3d

l2l_intersection

In [9]:
```
i_t=time.time()
p0=[[1,2,1],[5,4,3],[2,8,5]]

p1=[[10,2,1],[5,1,3],[12,8,-5]]
line=p2p_intersection_line(p0,p1)
line1=l_sec_ip_3d(p0,line)
line2=l_sec_ip_3d(p1,line)

p2=l2l_intersection(line1,line2)

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

color("blue")p_line3dc({p0},.1,rec=1);
color("magenta")p_line3dc({p1},.1,rec=1);
color("cyan")p_line3d({line1},.1,rec=1);
color("green")p_line3d({line2},.1,rec=1);
color("magenta")points({[p2]},.5);



''')
f_t=time.time()
f_t-i_t
```

Out[9]:
```
0.2905282974243164
```

In [36]:
```
i_t=time.time()

# p0=translate([-2,0,-8.22],[[2,4,5],[7,9,15],[1,10,5]])
# p1=translate([-3,0,-5],[[5,10,3],[5,-7,5],[-10,5,10]])


p0=[[-2,5,0],[-5,0,0],[0,5,10]]
p1=[[0,-5,0],[0,10,0],[5,3,15]]

line=p2p_intersection_line(p0,p1)
line1=l_sec_ip_3d(p0,line)
line2=l_sec_ip_3d(p1,line)

line3=[mean(p0,0).tolist(),add(mean(p0,0),multiply(nv(p0),10)).tolist()]
line4=[mean(p1,0).tolist(),add(mean(p1,0),multiply(nv(p1),10)).tolist()]
line5=array([array(p0).mean(0)-cross(nv(p0),nv(p1)),array(p0).mean(0)+cross(nv(p0),nv(p1))]).
line6=array([array(p1).mean(0)-cross(nv(p0),nv(p1)),array(p1).mean(0)+cross(nv(p0),nv(p1))]).
line7=array([array(p0).mean(0),array(p0).mean(0)+cross(nv(p0),cross(nv(p0),nv(p1)))*15]).toli
line8=array([array(sl_int1(p1,line3)[0]),array(sl_int1(p1,line3)[0])-cross(nv(p1),cross(nv(p0
p2=sl_int1(p1,line3)[0]
p3=l2l_intersection(line7,line8)
p4=array(p0).mean(0).tolist()
p5=sl_int1(p0,line4)[0]

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

color("blue")p_line3dc({p0},.1,rec=1);
color("magenta")p_line3dc({p1},.1,rec=1);
//color("cyan")p_line3d({line},.1,rec=1);
//color("cyan")p_line3d({line1},.1,rec=1);
color("green")p_line3d({line2},.1,rec=1);
color("green")p_line3d({line3},.1,rec=1);
color("magenta")p_line3d({line4},.1,rec=1);
color("magenta")p_line3d({line5},.1,rec=1);
color([.2,.3,.7,.2])p_line3d({line6},.1,rec=1);
```

```
color([.1,.3,.9,1])p_line3d({line7},.1,rec=1);
color([.1,.3,.2,1])p_line3d({line8},.1,rec=1);
color([.3,.2,.6,1])points({[p2]},.3);
color([.3,.2,.1,1])points({[p3]},.3);
color([.1,.2,.9,1])points({[p4]},.3);
color([.5,.5,1,1])points({[p5]},.3);

polyhedron({p0},[[0,1,2]]);
polyhedron({p1},[[0,1,2]]);

''')
f_t=time.time()
f_t-i_t
```

Out[36]:

```
0.14110994338989258
```

i_p_p

i_p_n

i_p_t

o_3d

ip_fillet

In [26]:

```
i_t=time.time()
sol=o_solid([1,0,0],circle(5),30,-15)
sol1=o_solid([0,1,0],circle(4.8),30,-15)
sol1=slice_sol(sol1,2)
fillet1=ip_fillet(sol,sol1,2,-2,o=-1)
fillet2=ip_fillet(flip(sol),flip(sol1),2,-2,o=-1)

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

%{swp(sol)}
%{swp(sol1)}

{swp_c(fillet1)}
{swp_c(fillet2)}



''')
f_t=time.time()
f_t-i_t
# len(i_p),len(i_p1),len(i_p2)
```

Out[26]:

```
0.13841676712036133
```

In [8]:

```
i_t=time.time()
sec=corner_radius(pts1([[-5,-10,1],[10,0,1],[0,15,1],[-10,0,1]]),10)
path=corner_radius(pts1([[-5,0],[5,0,1],[0,20,1],[-5,0]]),10)
sol=prism(sec,path)
sec1=circle(2,s=100)
path1=bezier(pts2([[0,-4,2],[0,5,10],[10,1,20]]),20)
sol1=path_extrude_open(sec1,path1)

p1=ip_sol2sol(sol,sol1,-1)

p2=i_p_p(sol1,p1,1)
p3=o_3d(p1,sol,-1)

fillet1=convert_3lines2fillet_closed(p3,p2,p1)

with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

%{swp(sol)}
%{swp(sol1)}
{swp_c(fillet1)}

    ''')
f_t=time.time()
f_t-i_t
```

Out[8]:

```
1.015195608139038
```

In [42]:

```
i_t=time.time()
p1=[[0,-31],[21-5,0,.2],[2,10,4],[35,0,10],
    [5,22,5],[-5,22,10],[-35,0,4],[-2,10,.2],[-21+5,0]]

path1=corner_radius(pts1(p1),10)
sec1=circle(5,s=72)
sol1=f_prism(sec1,path1)



sec5=corner_radius(pts1([[-20,-7.5,2.45],[5,0,2.45],[0,10,3],[15,2,70],[15,-2,3],[0,-10,2.45]
             [5,0,2.45],[1,7.5,5],[-1,7.5,7],[-20,3,90],[-20,-3,7],[-1,-7.5,5]]),10)


sec5=equidistant_pathc(sec5,201)
sec6=scl2d_c(sec5,.6)
sol2=[c2t3(sec5)]+[translate([0,0,120],sec6)]
sol2=translate([0,41,0],q_rot(['x90','z190'],sol2))

# p1=ip_surf(sol1,sol2)
# p2=i_p_p(sol2,p1,6)
# p3=o_3d(p1,sol1,6)
# fillet1=convert_3lines2fillet_closed(p1,p2,p3)
fillet1=ip_fillet(sol1,sol2,6,-6)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

%{swp(sol1)}
%{swp(sol2)}
{swp_c(fillet1)}
```

```
''')

f_t=time.time()
f_t-i_t
# len(p1),len(p2),len(p3)
```

Out[42]: 1.4900317192077637

In [8]:

```
i_t=time.time()

p1=[[0,-31],[21-5,0,.2],[2,10,4],[35,0,10],
    [5,22,5],[-5,22,10],[-35,0,4],[-2,10,.2],[-21+5,0]]

path1=corner_radius(pts1(p1),10)
sec1=circle(5,s=72)
sol1=prism(sec1,path1)



sec5=corner_radius(pts1([[-20,-7.5,2.49],[5,0,2.49],[0,10,3],[15,2,70],[15,-2,3],[0,-10,2.49]
             [5,0,2.49],[1,7.5,5],[-1,7.5,7],[-20,3,90],[-20,-3,7],[-1,-7.5,5]]),10)


sec5=equidistant_pathc(sec5,200)
sec6=scl2d_c(sec5,.6)
sol2=[c2t3(sec5)]+[translate([0,0,120],sec6)]
sol2=translate([0,41,0],q_rot(['x90','z190'],sol2))
p1=ip(sol1,sol2)

p2=ip(sol1,offset_sol(sol2,8,1))
# p2=sort_points(p1,p2)
# p2=sort_points(p1,p2)
p3=i_p_p(sol2,p1,8)
# p3=sort_points(p1,p3)

fillet1=convert_3lines2fillet_closed(p2,p3,p1)
```

```
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>

{swp(sol1)}
{swp(sol2)}
//%{swp(offset_sol(sol2,6,1))}
{swp_c(fillet1)}
color("blue")p_line3dc({p2},.2,rec=1);
color("green")p_line3dc({p3},.2,rec=1);

color("magenta")p_line3dc({p1},.2,rec=1);


''')
len(p1),len(p2),len(p3)
f_t=time.time()
f_t-i_t
```

Out[8]: 3.0832877159118652

In [33]:

```
# m10
t0=time.time()

sec1=arc(20,0,359,s=150)
path1=[[0,0],[-5,25]]

surf1=prism(sec1,path1)

sec2=corner_radius(pts1([[-25,0],[10,5,5],[10,-3,10],[10,5,5],[10,-8,7],[10,1]]),10)
path2=cytz(corner_radius(pts1([[-35,5,0],[10,8,20],[20,-5,10],[20,8,20],[10,-9,20],[10,1,0]])
surf2=surf_extrude(sec2,path2)
surf3=surf_extrudef(surf2)
# p1=ip_surf(surf2,surf1)
# p2=o_3d_surf(p1,surf2,2)
# p3=i_p_p(surf1,p1,2)
# # # p=fillet_surf2sol(surf2,surf1,2,10,0)
# fillet1=convert_3lines2fillet_closed(p1,p3,p2)

fillet1=ip_fillet_surf(surf2,surf1,2,-2)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies.scad>
```

```
%{swp(surf1)}
%{swp_c(surf3)}
{swp_c(fillet1)}



''')
t1=time.time()
total=t1-t0
total
```

Out[33]: 0.6894388198852539

In [42]:

```
t1=time.time()

p1=[[0,-15,.5],[6,0,.3],[0,-16,.1],[1,-1,.1],[4,0,.2],[2,10,4],[35,0,10],
    [5,22,5],[-5,22,10],[-35,0,4],[-2,10,.2],[-4,0,.1],[-1,-1,.1],[0,-16,.3],
    [-6,0,.5]]
sec1=corner_radius(pts1(p1),10)
path1=c2t3(circle(10,s=72))
sol1=path_extrude_closed(sec1,path1)

sec3=circle(7,s=100)
path2=corner_radius(pts1([[2,0],[-2,31]]),10)

sol3=translate([51,0,12],prism(sec3,path2))
# px=ip_surf(sol1,sol3)
# py=i_p_p(sol3,px,3)
# pz=o_3d_surf(px,sol1,3)
# fillet1=convert_3lines2fillet_closed(px,py,pz)
fillet1=ip_fillet(sol1,sol3,3,-3)

f3=end_cap(sol3,2)[1]
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

%{swp_c(sol1)}
difference(){{
{swp(sol3)}
```

```
{swp_c(f3)}
}}
{swp_c(fillet1)}

//color("blue")p_line3dc({sol3[0]},.2);
    ''')

t2=time.time()
t2-t1
# len(p1),len(p2),len(p3)
```

Out[42]:

```
1.56980299949646
```

40
20
-20

In [12]:
```
line=[[0,0],[10,0]]
pnts=[[10,15]]
d=1e-10

perp_points_d(line,pnts,d),perp_distance_within_line(line,pnts)
```

Out[12]:
```
([], [15.0])
```

In [43]:
```
t0=time.time()
sec=corner_radius(pts1([[0,0],[40,0],[0,40],[-40,0]]),10)
path=corner_radius(pts1([[-20,0],[20,0],[0,10],[-20,0]]),10)

sol1=prism(sec,path)

sec1=circle(7.5,s=100)
path1=corner_radius(pts1([[-7,0],[7,0],[-7.49,40]]),10)
sol2=prism(sec1,path1)
sol2=axis_rot_o([1,0,0],translate([-0.01,20,12],q_rot(['y90'],sol2)),180)

a=array([[1-cos(d2r(i)),1-sin(d2r(i))] for i in linspace(0,90,100)])*5
b=[rsz3dc(sol1,array(bb(sol1))+i*2) for i in a[:,0]]
c=[rsz3dc(sol2,array(bb(sol2))+i*2) for i in a[:,1]]


with open('trial.scad','w+') as f:
    f.write(f'''
    difference(){{
    union(){{
    ''')
    for i in range(len(a)-1):
        f.write(f'''
//include<dependencies2.scad>
```

```
hull(){{
intersection(){{
{swp(b[i])}
{swp(c[i])}
}}

intersection(){{
{swp(b[i+1])}
{swp(c[i+1])}
}}
}}

''')
    f.write(f'''

    }}
    translate([-10,-5,-2])cube([10,50,30]);
    }}
    {swp(sol1)}
    {swp(sol2)}

    ''')

t1=time.time()
t1-t0
```

Out[43]:

```
0.3255009651184082
```

partial_surface

shield

In [44]:

```
i_t=time.time()
sec1=circle(55)
path1=corner_radius(pts1([[-50,0],[50,0,.2],[0,30,3],[6,1,3],[0,6,3],[-4,2,3],[0,22,6],[8,2,6
# path1=equidistant_path(path1,200)
sec2=circle(7.5)
path2=corner_radius(pts1([[-5,0],[5,0,5],[0,35,2],[-5,0]]),10)
path2=equidistant_path(path2,50)
sol1=prism(sec1,path1)
sol2=translate([57.5,0,37],prism(sec2,path2))
```

```
sol2=axis_rot_o([0,0,1],sol2,180)

s1=shield(sol1,sol2,50,10,4,135)
v,f1=partial_surface(sol1,prism_center(sol2),50)


with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

%{swp(sol1)}
%{swp(sol2)}

color("blue")for(p={s1})for(p1=p)p_line3dc(p1,.2,rec=1);
polyhedron({v},{f1});

''')


f_t=time.time()
f_t-i_t
# len(p1),len(p2),len(p3)
```

Out[44]:

```
0.5128381252288818
```

In [45]:

```
# example of function surface_for_fillet(sol1=[],sol2=[],factor1=50,factor2=10,factor3=1,fact
t0=time.time()

sec=circle(10)
path=corner_radius(pts1([[-8,0],[10,0],[-2,0,2],[-1,15,3],[-8.9,0]]),10)
path=equidistant_path(path,100)
sol1=q_rot(['z90'],prism(sec,path))

sec1=corner_radius(pts1([[0,0,1],[5,0,1],[0,7,2.3],[-5,0,2.3]]),10)
path1=corner_radius(pts1([[-2.4,0],[2.4,0,2],[0,5,.3],[-.5,0]]),10)
path1=equidistant_path(path1,30)
```

```
sol2=translate([6,0,12],q_rot(['x90','z90'],prism(sec1,path1)))

i_p1=shield(sol1,sol2,100,20,4,23)
v,f1=partial_surface(sol1,prism_center(sol2),10)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
%{swp(sol1)}
%{swp(sol2)}
color("blue") for(p={i_p1})for(p1=p)p_line3dc(p1,.05,rec=1);
polyhedron({v},{f1});

''')

t1=time.time()
t1-t0

# len(ip2),len(ip3),len(ip4)
```

Out[45]:

```
0.8456509113311768
```

In [32]:

```
i_t=time.time()
sec1=circle(55)
path1=corner_radius(pts1([[-50,0],[50,0,.2],[0,30,3],[6,1,3],[0,6,3],[-4,2,3],[0,22,6],[8,2,6
# path1=equidistant_path(path1,200)
sec2=circle(7.5)
path2=corner_radius(pts1([[-5,0],[5,0,5],[0,35,2],[-5,0]]),10)
path2=equidistant_path(path2,100)
sol1=prism(sec1,path1)
sol2=translate([57.5,0,37],prism(sec2,path2))
sol2=axis_rot_o([0,0,1],sol2,180)
```

```
v,f1=partial_surface(sol1,prism_center(sol2),30)

i_p1=ip_tri2sol(v,f1,cpo(sol2))
p1=[p[0] for p in i_p1]
p2=[p[-1] for p in i_p1]
p3=flip(p1)+p2

fillet1=i_line_tri_fillet(v,f1,sol2,p3,3,-3,s=20)


with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

%{swp(sol1)}
%{swp(sol2)}
//%polyhedron({v},{f1});

{swp_c(fillet1)}

''')


f_t=time.time()
f_t-i_t
# len(p3),len(p4),len(p5)
```

Out[32]: 2.132855176925659

In [31]:

```
t1=time.time()

p1=[[0,-15,.5],[6,0,.3],[0,-16,.1],[1,-1,.1],[4,0,.2],[2,10,4],[35,0,10],
    [5,22,5],[-5,22,10],[-35,0,4],[-2,10,.2],[-4,0,.1],[-1,-1,.1],[0,-16,.3],
    [-6,0,.5]]
sec1=corner_radius(pts1(p1),10)
path1=c2t3(circle(10,s=72))
sol1=path_extrude_closed(sec1,path1)

sec3=circle(7,s=100)
path2=corner_radius(pts1([[2,0],[-2,31]]),10)

sol3=translate([51,0,12],prism(sec3,path2))
```

```
v,f1=partial_surface(sol1,prism_center(sol3),30)
p2=ip_tri2sol(v,f1,sol3)
p2=[p[0] for p in p2]
fillet1=i_line_tri_fillet(v,f1,sol3,p2,3,-3)

f3=end_cap(sol3,2)[1]
with open('trial.scad','w+')as f:
    f.write(f'''
include<dependencies2.scad>

%{swp_c(sol1)}
%difference(){{
{swp(sol3)}
{swp_c(f3)}
}}
{swp_c(fillet1)}
polyhedron({v},{f1});
color("blue")points({p2},.2);

    ''')

t2=time.time()
t2-t1
# len(p1),len(p2),len(p3)
```

Out[31]: 0.47414708137512207

In [50]:

```
i_t=time.time()


r=26.27
cp1,cp2,cp3,cp4=[0,0],[0,r],[r*cos(d2r(90+120)),r*sin(d2r(90+120))],[r*cos(d2r(90+240)),r*sin
r1,r2=22.5,6
```

```
a1=t_cir_tarc(r1,r2,cp1,cp2,7.5,0)
a2=t_cir_tarc(r1,r2,cp1,cp2,7.5,1)
a3=t_cir_tarc(r1,r2,cp1,cp3,7.5,0)
a4=t_cir_tarc(r1,r2,cp1,cp3,7.5,1)
a5=t_cir_tarc(r2,r1,cp4,cp1,7.5,1)
a6=t_cir_tarc(r2,r1,cp4,cp1,7.5,0)

a12=arc_2p(a1[-1],a2[0],r2,-1)[1:-1]
a23=arc_2p(a2[-1],a3[0],r1,-1)[1:-1]

a34=arc_2p(a3[-1],a4[0],r2,-1)[1:-1]
a45=arc_2p(a4[-1],a5[0],r1,-1)[1:-1]

a56=arc_2p(a5[-1],a6[0],r2,-1)[1:-1]
a61=arc_2p(a6[-1],a1[0],r1,-1)[1:-1]

sec1=a1+a12+a2+a23+a3+a34+a4+a45+a5+a56+a6+a61




path1=corner_radius(pts1([[-22,0],[22,0],[0,3],[-22,0]]),10)
sol1=prism(sec1,path1)


sec2=circle(33.75/2,s=100)
path2=corner_radius(pts1([[0,0.001],[0,8.63],[-1.125,0],[0,3.75],[1.125,0],[0,7.5],[-1.125,0]
sol2=prism(sec2,path2)

fillet1=ip_fillet(sol1,sol2,1.88,-1.88)

sol3=translate([0,0,-.1],linear_extrude(circle(14.06,s=100),30))

sol4=translate([0,0,-.1],linear_extrude(circle(2.81,[0,26.27]),4))
sol4=[q_rot([f'z{i}'],sol4) for i in [0,120,240]]

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
//color("magenta")p_line({sec1},.1);

difference(){{
union(){{
{swp(sol1)}
{swp(sol2)}
}}
{swp(sol3)}
for(p={sol4})swp(p);

}}
{swp_c(fillet1)}
''')

f_t=time.time()
f_t-i_t
```

Out[50]: 2.7332160472869873

In [19]:

```
i_t=time.time()

sec1=r_sec(60,60,[-55/2,0],[55/2,0],s=50)[:-1]
path1=corner_radius(pts1([[0,0],[0,8],[-14.5,0,2],[0,24,20],[-25,0]]),10)

sol1=prism(sec1,path1)
sol1=sol1+[sort_points(sol1[-1],[[0,0,24+8]])]
sec2=oset(sec1,-22.5)
path2=corner_radius(pts1([[0,-0.01],[0,24.01,12],[-12-25.5,0]]),10)
sol2=prism(sec2,path2)
sol2=sol2+[sort_points(sol2[-1],[[0,0,24]])]

sec3=circle(8)
path3=corner_radius(pts1([[0,16],[0,27,2],[7,0,2],[0,5]]),10)
sol3=prism(sec3,path3)

fillet1=ip_fillet(sol1,sol3,2,-2)
fillet2=ip_fillet(sol2,flip(sol3),2,-2)

sol4=translate([34.75,0,28],linear_extrude(circle(9),8))
fillet3=ip_fillet(sol1,sol4,2,-2)

sol5=translate([0,0,16-.5],linear_extrude(circle(4),33))
sol6=translate([34.75,0,24-.5],linear_extrude(circle(5),13))

sol7=translate([0,52.5,-.1],linear_extrude(circle(4),9))
sol8=[translate([-55/2,0,0],q_rot([f'z{i}'],sol7)) for i in [0,60,120,180]]
sol9=[translate([55/2,0,0],q_rot([f'z{i}'],sol7)) for i in [0,-60,-120,-180]]
```

```
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
//color("blue")p_line({sec1},.05);
//color("blue")p_lineo({path1},.2);
sol8={sol8};
sol9={sol9};
difference(){{
union(){{
difference(){{
{swp(sol1)}
{swp(sol2)}
for(i=[0,1,2,3])swp(sol8[i]);
for(i=[0,1,2,3])swp(sol9[i]);
}}
{swp(sol3)}
{swp(sol4)}
}}
{swp(sol5)}
{swp(sol6)}
}}

{swp_c(fillet1)}
{swp_c(fillet2)}
{swp_c(fillet3)}


//color("blue")for(p={sol1})p_line3dc(p,.2,rec=1);
''')

f_t=time.time()
f_t-i_t
```

```
C:\openscad\openscad-main\openscad1.py:4706: RuntimeWarning: divide by zero encountered in di
vide
  t=einsum('kl,ijkl->ijk',cross(p01,p02),la[:,:,None]-p0)/(einsum('ijl,kl->ijk',(-lab),cross
(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4706: RuntimeWarning: invalid value encountered in div
ide
  t=einsum('kl,ijkl->ijk',cross(p01,p02),la[:,:,None]-p0)/(einsum('ijl,kl->ijk',(-lab),cross
(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4707: RuntimeWarning: divide by zero encountered in di
vide
  u=einsum('ijkl,ijkl->ijk',cross(p02[None,None,:,:],(-lab)[:,:,None,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4707: RuntimeWarning: invalid value encountered in div
ide
  u=einsum('ijkl,ijkl->ijk',cross(p02[None,None,:,:],(-lab)[:,:,None,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4708: RuntimeWarning: divide by zero encountered in di
vide
  v=einsum('ijkl,ijkl->ijk',cross((-lab)[:,:,None,:],p01[None,None,:,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
C:\openscad\openscad-main\openscad1.py:4709: RuntimeWarning: invalid value encountered in add
  condition=(t>=0)&(t<=1)&(u>=0)&(u<=1)&(v>=0)&(v<=1)&(u+v<1)
C:\openscad\openscad-main\openscad1.py:4711: RuntimeWarning: invalid value encountered in mul
tiply
  a=(la[:,None,:,None,:]+lab[:,None,:,None,:]*t[:,None,:,:,None])
C:\openscad\openscad-main\openscad1.py:4708: RuntimeWarning: invalid value encountered in div
ide
  v=einsum('ijkl,ijkl->ijk',cross((-lab)[:,:,None,:],p01[None,None,:,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
```

Out[19]:

```
3.269057035446167
```

In [32]:

```
i_t=time.time()

a1=c2t3(arc_2p([0,0],[5,28],58,-1))
a2=flip(c2t3(arc_2p([-1,2],[3,28],56,-1)))

a3=[[-5,0,0],[0,0,3]]+a1[2:-1]+[[5,28,.9],[3,28,.9]]+a2[1:-1]+[[-1,2,2],[-5,2,0]]
path1=corner_radius(a3,10)
sec1=circle(43/2,s=100)
sol1=prism(sec1,path1)

c1=circle(7.75,[10,18])
p0=[0,8]
p1=p_cir_t(p0,c1)
p2=c1[19]
a4=arc_long_2p(p1,p2,7.75,-1,s=50)
path2=cytz([p0]+a4)
sec2=circle(2)
sol2=translate([18.7,0,-3],align_sol_1(path_extrude_open(sec2,path2)))

a5=[[-5,0,0],[0,0,5]]+a1[1:-1]+[[5,28,1],[3,28,0]]
path3=corner_radius(a5,10)
sol3=prism(sec1,path3)
fillet1=ip_fillet(sol3,sol2[:-10],2,-2)
fillet2=ip_fillet(sol3,flip(sol2[30:]),2,2)

sol4=cut_plane([0,-1,0],[100,100],100)
with open('trial.scad','w+') as f:
    f.write(f'''

difference(){{
union(){{
{swp(sol1)}
difference(){{
{swp(sol2)}
{swp(sol3)}
}}
{swp(cpo(fillet1)[:-1])}
{swp(cpo(fillet2)[:-1])}
}}
//{swp(sol4)}
}}

''')
```

```
f_t=time.time()
f_t-i_t
```

Out[32]: 5.763791799545288

In [53]:

```
sec=corner_radius(pts1([[-2.5,-2.5,0],[5,0,2.5],[0,2.5,0.5],[5,0,0]]),10)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
color("blue")p_lineo({sec},.05);

''')
```

In [23]:

```
s=100
x=2
a=linspace(0,4,s)
b=sin(d2r(720/x*a))

theta=720/x*a
c=cos(d2r(theta))
d=sin(d2r(theta))
e=array([[cos(d2r(i)),sin(d2r(i))] for i in linspace(0,360,s)])
e=einsum('ij,i->ij',e,abs(b)).tolist()
sw=array([a,b]).transpose(1,0).tolist()

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies.scad>
e={e};
sw={sw};
color("blue")p_lineo(loop(sw,0,100*$t),.05);
color("magenta")p_lineo(loop(e,0,100*$t),.05);



''')
```

In [10]:
```
s=200
x=2
a=linspace(0,4,s)
b=sin(d2r(270/x*a))

theta=270/x*a
c=cos(d2r(theta))
d=sin(d2r(theta))
e=array([[cos(d2r(i)),sin(d2r(i))] for i in linspace(0,360,s)])
e=einsum('ij,i->ij',e,abs(b)).tolist()
sw=array([a,b]).transpose(1,0).tolist()

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies.scad>
e={e};
sw={sw};
color("blue")p_lineo(loop(sw,0,200*$t),.05);
color("magenta")p_lineo(loop(e,0,200*$t),.05);



''')
```

In [20]:
```
# 3d knots various types
t0=time.time()
# trefoil knot

# path=[[10*(sin(t)+2*sin(2*t)),
#       10*(cos(t)-2*cos(2*t)),
#       -10*sin(3*t)] for t in d2r(arange(0,360))]

# circular sin theta knot

# path=[[60*(cos(t)),
#       60*(sin(t)),
#       20*sin(4*t)*cos(4*t)] for t in d2r(arange(0,360))]

# random knot
```

```
# path=[[20*(-0.22*cos(t) - 1.28*sin(t) - 0.44*cos(3*t) - 0.78*sin(3*t)),
# 20*(-0.1*cos(2*t) - 0.27*sin(2*t) + 0.38*cos(4*t) + 0.46*sin(4*t)),
# 20*(0.7*cos(3*t) - 0.4*sin(3*t))] for t in d2r(arange(0,360))]

# torus knots

# path=[[10*cos(3*t)*(3+cos(4*t)),
# 10*sin(3*t)*(3+cos(4*t)),
# 10*sin(4*t)] for t in d2r(arange(0,360))]

# cinquefoil torus knots
# a,p,q=3,3,16
# d=10

# explanation
# radius of the torus = a*d
# section radius of the torus = d
# p in number of cycles of the wrapping coil over torus
# q in the number of turns of the wrapping coil over torus

# path=[[d*cos(p*t)*(a+cos(q*t)),
# d*sin(p*t)*(a+cos(q*t)),
# -d*sin(q*t)] for t in d2r(arange(0,360,1))]



# Lissajous knots

path=[[10*cos(3*t+5),
10*cos(3*t+10),
10*cos(3*t+2)]for t in d2r(arange(0,360))]
r=2
sec=circle(r)
sol=align_sol_1(path_extrude_closed(sec,path))

# sec1=circle(d-r)
# path1=c2t3(circle(a*d))
# sol1=path_extrude_closed(sec1,path1)

with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies.scad>
//color("blue")p_line3d({path},4);
sol={sol};
//color("magenta")swp_c(loop(sol,0,360*$t));
//color([.2,.5,.7,.3])
{swp_c(sol)}

//%{swp_c(sol1)}

''')
t1=time.time()
t1-t0
```

Out[20]:

```
2.4420342445373535
```

In [20]:

```
sec=circle(25)
path=corner_radius(pts1([[0,0,0],[0,15,1],[-6,50,1],[0,18,0]]),10)
sol=prism(sec,path)
sol1=prism(circle(24),path)
sol0=swp_prism_h(sol,sol1)
sec2=circle(15)
path2=cr_3d([[0,0,15,0],[-60,0,40,20],[0,0,30,0]],10)
sol2=path_extrude_open(sec2,path2)
sol3=path_extrude_open(oset(sec2,-1),path2)
sol02=swp_prism_h(sol2,sol3)
fillet1=ip_fillet(sol,sol2,5,-5)

sec3=corner_radius(pts1([[0,0],[-2,1,.2],[2,1]]),10)
path3=helix(14,2.5,6,5)
sol4=path_extrude_open(sec3,path3)

sol4=sol2vector([0,0,1,],sol4,[-60,0,70])
with open('trial.scad','w+') as f:
    f.write(f'''
difference(){{
{swp_c(sol0)}
{swp(sol3)}
}}
difference(){{
{swp_c(sol02)}
{swp(sol)}
}}
{swp_c(fillet1)}
intersection(){{
color("blue"){swp(sol4)}
{swp(sol3)}
}}

''')
```

sinwave-box

In [2]:

```
i_t=time.time()
# sinwave glass
height=125
dia=100
width=pi*dia
factor=round(width/height,0)
sec=[[[i,j,1*sin(d2r(i*360/height*3))*sin(d2r(j*360/width*3*factor))] for j in linspace(0,wid
# path=translate([0,100/pi/2,100/pi/2],q_rot(['y90'],arc(100/pi/2,0,400,s=200)))
path=q_rot(['y90'],arc(dia/2,0,400,s=200))

surf1=[wrap_around(p,path)[:-1] for p in sec]

surf2=offset_sol(surf1,-2)

sol1=q_rot(['y-90'],swp_prism_h(surf2,surf1))
sol2=q_rot(['y-90'],surf1[:2])

p0=sol1[2][:-1]
p1=sol1[15][:-1]
p2=offset_3d(p0,-15)
fillet1=convert_3lines2fillet_closed(p2,p1,p0,s=30)

sol3=flip(sol1)[:-15]+flip(cpo(fillet1)[1:-1])

sol4=cut_plane([-1,0,0],[300,300],300,0,0,0)
with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
    difference(){{
   {swp(sol3)}
   //{swp(sol4)}

   }}
    ''')
f_t=time.time()
f_t-i_t
```

Out[2]:

```
4.202970266342163
```

In [3]:

```
i_t=time.time()
# sinwave-box
d=100
s=30
path=corner_radius(pts1([[-d/2,-d/2,d/5],[d,0,d/5],[0,d,d/5],[-d,0,d/5]]),s)
path=path[s+1:]+path[:s]
path=equidistant_pathc(q_rot(['y90'],path),500)
path=path+[path[0]]
l1=int(l_lenv(path))
sec=[[[i,j,1*sin(d2r(i*360/125*3))*sin(d2r(j*360/l1*6))] for j in linspace(0,l1,300)] for i i

surf1=[wrap_around(p[:-1],path) for p in sec]
surf2=offset_sol(surf1,-2)
sol1=q_rot(['y-90'],swp_prism_h(surf1,surf2))

p0=sol1[-4][:-1]
```

```
p1=sol1[-15][:-1]
p2=offset_3d(p0,-11)
fillet1=convert_3lines2fillet_closed(p2,p1,p0,s=30)
sol2=sol1[:-12]+flip(cpo(fillet1)[1:-1])

sol3=cut_plane([0,-1,0],[300,300],300,theta=[0,0,45])
with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

    difference(){{
    {swp(sol2)}
//{swp(sol3)}

}}
    ''')
# l_lenv_o(path)
f_t=time.time()
f_t-i_t
```

Out[3]: 8.23888373374939

q_rot2d

translate_2d

In [4]:
```
c1=circle(22.5)
c2=translate_2d([26.25,0],circle(6))
c3=[q_rot2d(i,c2)  for i in [0,120,240]]

a1=t_cir_tarc(22.5,6,[0,0],[26.25,0],7.5)
p0,p1=a1[0],a1[-1]

a2=t_cir_tarc(22.5,6,[0,0],[26.25,0],7.5,side=1)
p2,p3=a2[0],a2[-1]
p4=q_rot2d(120,p0)

sec=arc_2p(p0,p1,7.5,cw=1)+arc_2p(p1,p2,6,cw=-1)+ \
arc_2p(p2,p3,7.5,cw=1)+arc_2p(p3,p4,22.5,cw=-1)

sec=[q_rot2d(i,sec)  for i in [0,120,240]]

sec=remove_extra_points(concatenate(sec).round(5))

sol=linear_extrude(sec,5)


with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
//color("blue",.2)p_line3dc({c1},.3);
//color("magenta",.2)for(p={c3})p_line3dc(p,.3);

//color("cyan")p_line3dc({sec},.5);
//color("blue")points({[p4]},1);
{swp(sol)}

    ''')
```

In [5]:

```
peri=400
height=100
sec=corner_radius(pts1([[0,0],[9,0],[0,1],[1,0]]),10)
sec=concatenate([translate_2d([i,0],sec) for i in arange(0,peri,10)]).tolist()
sec1=translate_2d([4.5,5],sec)
sec2=[sec]+[sec1]
sec=concatenate([translate_2d([0,i],sec2)  for i in arange(0,height,10)]).tolist()
sec=[translate(array(p).mean(0),q_rot(['x90'],translate_2d(-array(p).mean(0),p)))  for p in s
sec1=translate([0,4.5,0],sec)
sec=array([sec,sec1]).transpose(1,0,2,3)
_,_,a,b=sec.shape
sec=sec.reshape(-1,a,b).tolist()
sec=translate([0,.1,0],q_rot(['z90'],sec))
path=circle(peri/(2*pi),s=100)
path=path+path[:10]
path=q_rot(['y90'],path)
sol=q_rot(['y90'],[wrap_around(p,path)  for p in sec])
sol1=offset_sol(sol,-10)

sol2=swp_prism_h(sol,sol1)
with open('trial.scad','w+') as f:
    f.write(f'''
include<dependencies2.scad>
//color("blue")for(p={sol})p_line3d(p,.2);
//color("magenta")p_line3d({path},.2);

{swp_c(sol2)}


    ''')
```

In [9]:

```
sec=corner_radius(pts1([[0,0],[70,0],[0,28],[-17.5,0,7],[0,24.5,17.5]
                        ,[-35.01,0,17.5],[0,-24.5,7],[-17.5,0]]),20)

cp_1=cp_arc(sec[26:30])
c1=circle(10,cp_1)
c2=circle(2.5,[7.5,14])
c3=circle(2.5,[62.5,14])
sol1=linear_extrude(sec,16)
sol2=[translate([0,0,-.5],linear_extrude(p,17))  for p in [c1,c2,c3]]
sol3=translate([-.5,-.5,12.5],cube([18,40,20]))
sol4=translate([70-17.5,-.5,12.5],cube([18,40,20]))
c4=circle(7.5,[-7.5,32.5])
p0=[0,0]
p1=p_cir_t(p0,c4)
p3=[-52.5+29,16]
p2=cir_p_t(c4,p3)
p4=[-52.5+17.5,16]
p5=[-52.5+17.5,0]
c5=circle(2.5,[-7.5,32.5])
sec1=[p0]+arc_2p(p1,p2,7.5,-1,30)+[p3,p4,p5]

sol5=linear_extrude(sec1,7.5)
sol6=translate([0,0,-.5],linear_extrude(c5,9))
with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
//color("blue")p_line3d({sec},.2,1);
//color("magenta")p_line3d({c1},.2,1);
//color("magenta")p_line3d({c2},.2,1);
//color("magenta")p_line3d({c3},.2,1);
//color("blue")points({[p0,p1,p2,p3,p4,p5]},.5);
```

```
//color("magenta")p_line3dc({sec1},.2,1);
for(i=[17.5,17.5+35-7.5])
translate([i+7.5,0,0])
rotate([90,0,-90])
difference(){{
{swp(sol5)}
{swp(sol6)}
}}

difference(){{
{swp(sol1)}
for(p={sol2})swp(p);
{swp(sol3)}
{swp(sol4)}
}}

    ''')
```

sinewave

cosinewave

e_wave

In [7]:
```
wav1=sinewave(50,6,1,200)
wav2=cosinewave(50,6,1,200)
wav3=e_wave(50,6,.1,200)



with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
```

```
color("blue") p_line3d({wav1},.2);
color("magenta") p_line3d({wav2},.2);
color("cyan") p_line3d({wav3},.2);



    ''')
```

In [6]:

```
wav1=sinewave(50,6,1,200)
wav2=sinewave(50,9,1,200)

a=[[wav1[i][0] , wav1[i][1]*wav2[i][1]  ]  for i in range(len(wav1))]
# b=[[wav1[i][0] , wav1[i][1]*wav2[i][1]  ]  for i in range(len(wav1))]

b=q_rot(['x90'],a)
c=q_rot(['x90','z90'],a)

surf_1=surface_from_2_waves(b,c,1)
surf_2=surf_extrudef(surf_1,-.1)

path=circle(50/2/pi+.01,s=100)
path=path+path[:3]
path=q_rot(['y90'],path)
sol=[ wrap_around(p,path) for p in surf_1]
sol=q_rot(['y-90'],sol)
h=[[0,0,p[0][2]] for p in sol]
s=c3t2(sol)
s1=[oset(p,-.5)  for p in s]
sol1=[translate(h[i],s1[i])  for i in range(len(s1))]
sol2=swp_prism_h(sol,sol1)
sol2=scl3d(sol2,2)
with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
{swp_c(sol2)}

    ''')
```

SurfaceFrom3LinesInDifferentPlanes

In [2]:
```
i_t=time.time()
w1=arc_3p_3d([[0,0,0],[5,20,0],[0,40,0]])
w2=arc_3p_3d([[0,0,0],[-4,0,20],[0,0,40]])
w3=arc_3p_3d([[0,0,40],[2,15,40],[0,30,45]])

surf_1=SurfaceFrom3LinesInDifferentPlanes(w1,w2,w3)
surf_2=surface_thicken(surf_1,-.5)
with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

{swp(surf_2)}

    ''')

f_t=time.time()
f_t-i_t
```

Out[2]: 0.3198533058166504

In [17]:
```
# complex part with fillet
i_t=time.time()

c1=circle(20)
c2=circle(5,[25,0])
f_1=two_cir_tarc(c1,c2,10,0)
f_2=two_cir_tarc(c1,c2,10,1)
p0,p1,p2,p3,p4,p5=f_1[0],f_1[-1],[70,-5],[70,5],f_2[0],f_2[-1]

sec=[p3]+arc_2p(p4,p5,10,1)+arc_long_2p(p5,p0,20,-1,s=50)+ \
arc_2p(p0,p1,10,1)+[p2]

sec=remove_extra_points(array(sec).round(5))
sec=equidistant_path(sec,1000)
sol=translate([0,0,-25],linear_extrude(sec,50))
sol1=translate([40,0,0],q_rot(['x90','z180'],sol))

ipa=ip_sol2sol(sol1,sol)
ipb=ip_sol2sol(sol1,sol,-1)

ipc=remove_extra_points(array(ipa+flip(ipb)).round(5))
fillet1=i_line_fillet_closed(sol,sol1,ipc,2,-2,10,n=300)
fillet2=solid_from_fillet_closed(fillet1,-4)
with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

    difference(){{
    intersection(){{
    {swp(sol)}
    {swp(sol1)}
    }}
{swp_c(fillet2)}
{swp(o_solid([0,0,1],circle(15),40,-20))}
{swp(o_solid([0,1,0],circle(15),40,-20,40))}

}}
    ''')

f_t=time.time()
f_t-i_t
```

```
C:\openscad\openscad-main\openscad1.py:4708: RuntimeWarning: invalid value encountered in div
ide
  v=einsum('ijkl,ijkl->ijk',cross((-lab)[:,:,None,:],p01[None,None,:,:]),(la[:,:,None,:]-p0[N
one,None,:,:]))/(einsum('ijl,kl->ijk',(-lab),cross(p01,p02))+.00000)
```

Out[17]:

```
3.7163662910461426
```

In [42]:

```
# mobile stand revised version
i_t=time.time()
sec=round_corners(pts1([[0,0,1.9],[150,0,1.9],[0,4,1.9],[-150,0,1.9]]),10)
path=round_corners(pts1([[-1.9,0],[1.9,0,1.9],[0,120,1.9],[-1.9,0]]),10)

sol=prism(sec,path)
sol=q_rot(['z90'],sol)
sol=[equidistant_pathc(p,400) for p in sol]
path1=arc_2p([0,0],[150,0],500,1,150)
path1=translate([0,0,120],q_rot(['x90','z90'],path1))

sol1=translate([0,0,-120+1.9],sol[-10:])
sol1=[wrap_around(p,path1) for p in sol1]

path2=arc_2p([0,0],[150,0],500,-1,150)
path2=translate([0,0,0],q_rot(['x90','z90'],path2))
sol2=sol[:10]
sol2=[wrap_around(p,path2) for p in sol2]

sol3=[sol2[-1]]+[sol1[0]]
sol3=slice_sol(sol3,100)
sol4=sol2+sol3+sol1
sol4=translate([0,10,0],q_rot(['y90','z90'],sol4))

path3=round_corners(pts1([[0,0],[127,0,6],[-50*cos(d2r(60)),50*sin(d2r(60))]]),10)
path3=q_rot(['x90','z90'],path3)

sol5=[wrap_around(p,path3) for p in sol4]

sec=round_corners(pts1([[6,0,1.9],[150-12,0,1.9],[0,4,1.9],[-150+12,0,1.9]]),10)
path=round_corners(pts1([[0,0],[0,1.9,1.9],[-1.9,0]]),10)
```

```
sol=prism(sec,path)
sol=q_rot(['z90'],sol)
path=arc_2p([0,0],[150,0],300,1,150)
path=translate([0,0,50],q_rot(['x90','z90'],path))

sol1=[wrap_around(equidistant_pathc(p,400),path) for p in sol]
sol2=translate([0,0,-50],equidistant_pathc(wrap_around(sol[0],path),400))
sol2=[sol2]+sol1
sol2=translate([0,100,1],q_rot(['z90','x30'],sol2))

sol6=[sol5[10]]+[sol5[90]]
sol7=[sol2[0]]+[sol2[1]]
fillet1=flip(ip_fillet(sol6,sol7,4,-3.8))

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
    {swp(sol5)}
    {swp(sol2)}
    {swp_c(fillet1)}

    ''')

f_t=time.time()
f_t-i_t
```

Out[42]: 6.964439392089844

points_inside_offset_surround

In [25]:

```
i_t=time.time()
sec=corner_radius(pts1([[0,0,1],[7,5,2],[5,7,3],[-5,7,2],[-7,5,3]]),10)
a=(random.random(5000)*(30-0)+(-10))
b=(random.random(5000)*(30-0)+(-5))
c=array([a,b]).transpose(1,0).tolist()
r=3
sec2=cs1(sec,r-.01)
p_0=points_inside_offset_surround(sec,c,r-.01)
with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>
    color("blue")p_line3dc({sec},.1,1);
    color("cyan")points({c},.2);
    color("green",.1)for(p={sec2})p_line3dc(p,.1,1);
    color("magenta")points({p_0},.2);

    ''')
f_t=time.time()
f_t-i_t
```

Out[25]: 2.2682666778564453

In [15]:

```
od=150
id=75
n=16
t=3
sl_ang=50
sl_h=(od/2-id/2)*tan(d2r(sl_ang))
a=c2t3(circle(od/2,s=n+1))
b=q_rot([f'z{360/len(a)/2}'],c2t3(circle(od/2,s=n+1)))
h=l_len(a[:2])/2

sol_1=[translate([0,0,i*h],a) if i%2==0
       else translate([0,0,i*h],b)
       for i in range(5)]
a=flip(c2t3(circle(od/2,s=n+1)))
b=flip(q_rot([f'z{-360/len(a)/2}'],c2t3(circle(od/2,s=n+1))))
h=l_len(a[:2])/2
sol_2=[translate([0,0,i*h],a) if i%2==0
       else translate([0,0,i*h],b)
       for i in range(5)]

a=c2t3(circle(id/2,s=n+1))
b=q_rot([f'z{360/len(a)/2}'],c2t3(circle(id/2,s=n+1)))
# h=L_Len(a[:2])/2

sol_3=[translate([0,0,i*h],a) if i%2==0
       else translate([0,0,i*h],b)
       for i in range(5)]

a=flip(c2t3(circle(id/2,s=n+1)))
```

```
b=flip(q_rot([f'z{-360/len(a)/2}'],c2t3(circle(id/2,s=n+1))))
# h=l_len(a[:2])/2
sol_4=[translate([0,0,i*h],a) if i%2==0
       else translate([0,0,i*h],b)
       for i in range(5)]

a=[seg(p)[:-1] for p in cpo(sol_1)]
b=[seg(p)[:-1] for p in translate([0,0,sl_h],cpo(sol_3))]

sol_5=array([a,b]).transpose(1,2,0,3,4).tolist()

a=[seg(p)[:-1] for p in cpo(sol_2)]
b=[seg(p)[:-1] for p in translate([0,0,sl_h],cpo(sol_4))]

sol_6=array([a,b]).transpose(1,2,0,3,4).tolist()

with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

    for(p={sol_5})for(p1=p)
        let(
        a=slice_sol(p1,10)
        )
        for(i=[1:len(a)-1])
    hull(){{
    p_line3d(a[i-1],{t/2},1);
    p_line3d(a[i],{t/2},1);
    }}

        for(p={sol_6})for(p1=p)

        let(
        a=slice_sol(p1,10)
        )
        for(i=[1:len(a)-1])
    hull(){{
    p_line3d(a[i-1],{t/2},1);
    p_line3d(a[i],{t/2},1);
    }}

    ''')
```

In [21]:

```
s1=ellipse(20,15,49)
s2=oset(s1,-.65)

s3=corner_radius(pts1([[0,-15],[0,12,15],[-17,1.5,1.5],[0,3.1,1.5],
                       [17,1.5,15],[0,12]]),10)
s3=translate_2d([10,0,0],s3)
s3=equidistant_path(s3,49)
p0=s2[-11]
p1=s3[10]
a1=c2t3(arc_2p(p0,p1,5,-1,10))
a2=mirror(a1,[0,1,0],[0,0,0])
sec_1=a1+c2t3(s3[10:-10])+flip(a2)+c2t3(s2[11:-10])
surf_1=[q_rot([f'x{i}'],s1[:25]) for i in linspace(0,180,30)]
sec_1=equidistant_path(sec_1,150)
sec_1=align_sec_2(sec_1)
sec_2=sec2surface(sec_1)
sol_1=surface_line_vector(c2t3(sec_1),[0,0,30])
sol_1=slice_sol(sol_1,29)[:-11]

l_1=cr_3d([[-30,0,3.5,0],[38,0,0,5],[0,0,9.5,4.3],[-35,0,-1,0]],10)
l_1=equidistant_path(l_1,500)
sol_2=surface_line_vector(l_1,[0,30,0],1)

l_2=ip_sol2sol(surf_1,sol_2)
l_3=ip_sol2sol(surf_1,sol_2,-1)
l_4=l_2+flip(l_3)
sol_3=surface_line_vector(offset_3d(l_1,-1),[0,30,0],1)

surf_2=[q_rot([f'x{i}'],oset(s1,-1)[:25]) for i in linspace(0,180,30)]

l_2=ip_sol2sol(surf_2,sol_2)
l_3=ip_sol2sol(surf_2,sol_2,-1)
l_5=path2path1(l_4,l_2+flip(l_3))
l_6=path2path1(l_4,o_3d(l_4,surf_1,1.1))
fillet_1=convert_3lines2fillet_closed(l_5,l_6,l_4)
fillet_1=solid_from_fillet_closed(fillet_1,-2)

l_1=equidistant_path(s3[8:-8],60)
l_2=path_offset(l_1,1)
l_3=project_line_on_surface(c2t3(l_1),cpo(surf_1),[0,0,1])
l_4=project_line_on_surface(c2t3(l_2),cpo(surf_1),[0,0,1])
```

```
l_5=ip_sol2sol(sol_2,linear_extrude(l_1,30),-1)
l_6=ip_sol2sol(sol_2,linear_extrude(l_2,30),-1)
l_7=slice_sol([l_5,l_3],2)[1]
fillet_2=convert_3lines2fillet(l_7,l_4,l_3,10)
fillet_2=flip(solid_from_fillet(fillet_2,2))
fillet_3=convert_3lines2fillet(l_6,l_7,l_5,10)
fillet_3=flip(solid_from_fillet(fillet_3,2))
with open('trial.scad','w+') as f:
    f.write(f'''
    include<dependencies2.scad>

 difference(){{
{swp(surf_1)}
{swp(flip(sol_1))}
{swp(sol_2)}
{swp_c(fillet_1)}
{swp(fillet_2)}
{swp(fillet_3)}
}}

    ''')
```