Note that this is for ALL segments, not just ground plane segments. The “-d grids” also will plot the current (not current density) at every node in the hierarchy by using the current in the segment pointing north for the y-direction and east for the x-direction. It outputs it in the file `Gridn_n.mat` as described in the FastHenry manual for uniform planes, and for nonuniform planes, this file should be converted to your favorite vector drawing format by the user. Its format for nonuniform planes is:

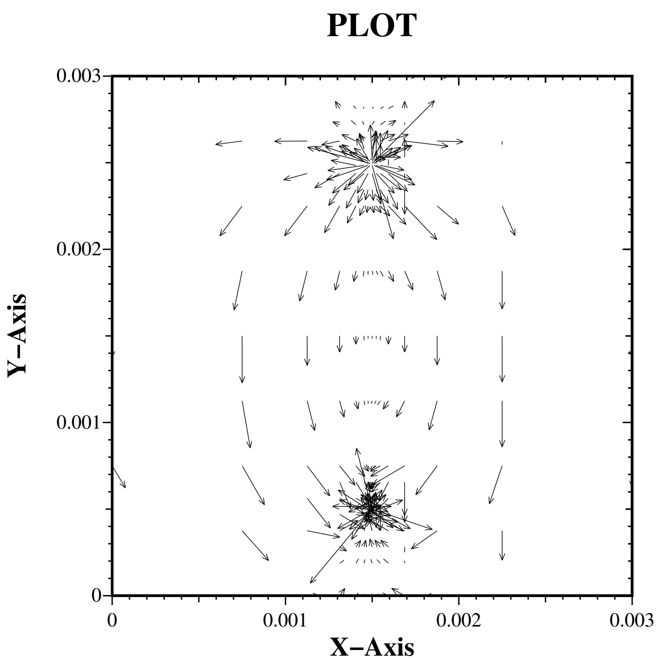
```
x y z xr +j xi yr + j yi
```

where (x,y,z) is the location of the vector and `xr+j xi` is the x-directed complex current and `yr + j yi` is the y-directed complex current.

Since the 3d example above has a much finer mesh than we need to observe, fasthenry was run on a coarser discretized problem in `3d_example2_coarse.inp`. Since it is difficult to make sense out of complex current, the frequency was set to 0 and the real part of the current was observed. FastHenry was run with

```
fasthenry -d grids -sludecomp 3d_example2_coarse.inp
```

LU decomposition was specified since the frequency is 0. The file Grid1_0.mat was then converted to an internal format used for vector drawing (basically awk was used to remove the +j xi and +j yi portions of the file). This yields the following plot:



Notice that since *current* and not current density is plotted the arrows for the current in the center of the plane are smaller than others along the x-direction. This is expected since the current in the x-direction is uniform, but the segments in the middle are smaller.

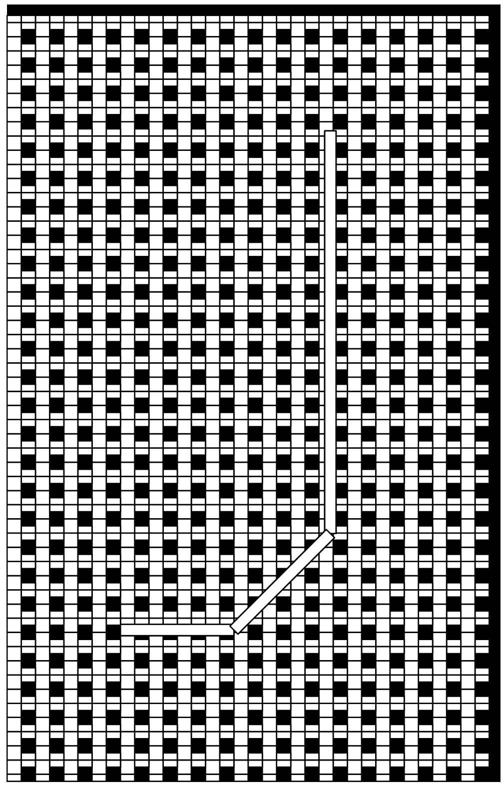
Using the `connection` and `trace` utilities

This is an example of using the highest level utilities: trace and connection. The `connection` utility creates an equipotential contact and also discretizes finely near it. The `trace` utility is used for telling the discretization routines that a trace is near to the plane and to discretize appropriately. The trace utility is most useful for traces that are not parallel to x and y since the `decay_rect` utility cannot be used. Here is an example of a trace sandwiched between a power and ground plane. The trace travels a short distance in x, some along a 45 degree bend and then a long distance in y. The partial inductance of the trace, the power plane path over the trace, and ground plane path below the trace will be computed to give a 3x3 impedance matrix. The planes are meshed. This is example file `trace_over_mesh_new.inp`:

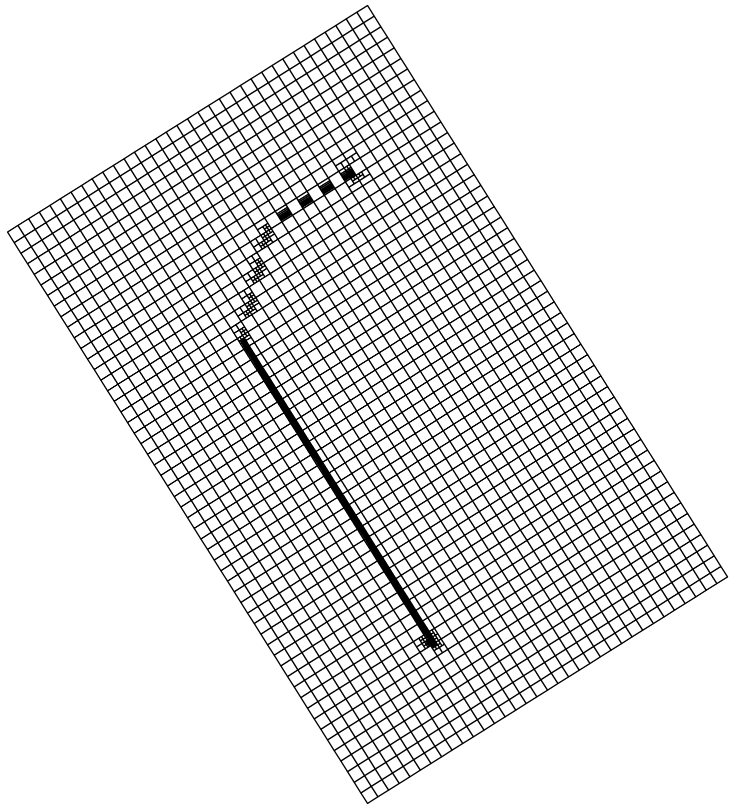
```
* A set of bending traces sandwiched between meshed planes
*  Units of microns
.units um

* default dimensions of traces
.default w=150 h=10

* do nodes on portion running along x-direction* starting x value is fixed for all the
traces along x
.default x = -3700 z = 86

nx0start y=0

.default x = -1700 z = 86
nx0end y=0

* we've done nodes, now make metal between them
ex0 nx0start nx0end

* Do something similar for traces running in y direction
.default y = 1700 z = 86
ny0start x=0

.default y = 8800 z = 86
ny0end x=0

ex0 ny0start ny0end

* Now do diagonal portion connecting x traces to y traces
exy0 nx0end ny0start

*The meshed plane on top
gpower x1=-5700 y1=-2666 z1=110 x2=2800 y2=-2666 z2=110
+      x3=2800 y3=10834 z3=110 thick=10 file=NONE
*
* do contacts to plane
+ contact connection nx_power0_1 (-3700,0,110,30,30,2.5)
+ contact connection ny_power0_1 (0,8800,110,30,30,2.5)
*
* Define initial meshed grid
+ contact initial_mesh_grid (34, 54)
*
* refinement under the signal traces for high freq
* the x-directed traces
+ contact trace (-3700,0,110,-1700,0,110,30,1)
* the y-directed traces
+ contact trace (0,1700,110,0,8800,110,30,1)
* the diagonal trace
+ contact trace (-1700,0,110,0,1700,110,30,5)
```

```
*The meshed plane on bottom
gground x1=-5700 y1=-2666 z1=0 x2=2800 y2=-2666 z2=0
+      x3=2800 y3=10834 z3=0 thick=13 file=NONE
*
* do contacts to plane
+ contact connection nx_ground0_1 (-3700,0,0,30,30,2.5)
+ contact connection ny_ground0_1 (0,8800,0,30,30,2.5)
*
* Define initial meshed grid
+ contact initial_mesh_grid (34, 54)
*
* refinement under the signal traces for high freq
* the x-directed traces
+ contact trace (-3700,0,0,-1700,0,0,30,1)
* the y-directed traces
+ contact trace (0,1700,0,0,8800,0,30,1)
* the diagonal trace
+ contact trace (-1700,0,0,0,1700,0,30,5)


* Define the ports
* The signal traces
.external nx0start ny0end signal_trace_0

* The power and ground paths
.external nx_power0_1 ny_power0_1 power_path_for_trace_0_and_1
.external nx_ground0_1 ny_ground0_1 ground_path_for_trace_0_and_1

* start at 125MHz and go up by factor of 2  (10^(0.3) ~= 2)
.freq fmin=125e6 fmax=500e6 ndec=3
.end
```

The geometry can be viewed by running FastHenry with the “-f simple -g thin” options and then running “zbuf zbuffile” to create the postscript zbuffile.ps. Actually, the follwing picture was created with “zbuf -m zbuffile” to produce a matlab file which can be viewed and printed from matlab (see the FastHenry manual).



To view just the plane discretization: "`fasthenry -f hierachy trace_over_mesh_new.inp`" produces the file `hier.qui` which can be turned into the postscript file hier.ps with "`zbuf hier.qui -e0 -a0`" and looks like what is shown on the next page.



Note that this is only a picture of the discretization of one of the two planes. The initial_mesh_grid covers the plane with a large grid of cells first. Every other cell in this case is actually a hole. The presence of the trace causes most of the additional refinement on the plane. Note that the refinement under the 45 degree section and the short x section seems to have gaps. This is actaully because the cells where refinement seems to have been “skipped” are actually holes in the plane. Also note the extra refinement under the ends of the traces where connections to the plane are made.