Learn the OpenAccess API

Using Python

Initial Contribution By

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Section 8: oaPRBoundary, oaLayerBlockage, oaTrackPattern

- OA has special objects for certain design concepts:
  - Cell boundary (oaPRBoundary)
  - Grids (oaTrackPattern)
  - Routing blockages/keepouts/obstructions (oaLayerBlockage)

oaPRBoundary

- Design content is typically encapsulated in a cell boundary
  - OA has an oaPRBoundary object
  - Only one oaPRBoundary object is allowed per block
  - The oaPRBoundary object accepts a list of points making up a polygon (although boundaries are often just a rectangle)

```
# Note - for brevity and because the built-in UU to DBU
# conversion functions are still beta, we will use our own UU to  # DBU
   conversion functions previously mentioned in Section 7.
bndpts = pts2dbu( [[0.0, 0.0], [0.0, 10.0], [10.0, 10.0], [10.0, 0.0]] )

# Create the cell boundary
bnd = oa.oaPRBoundary.create(block, bndpts)
```

oaLayerBlockage

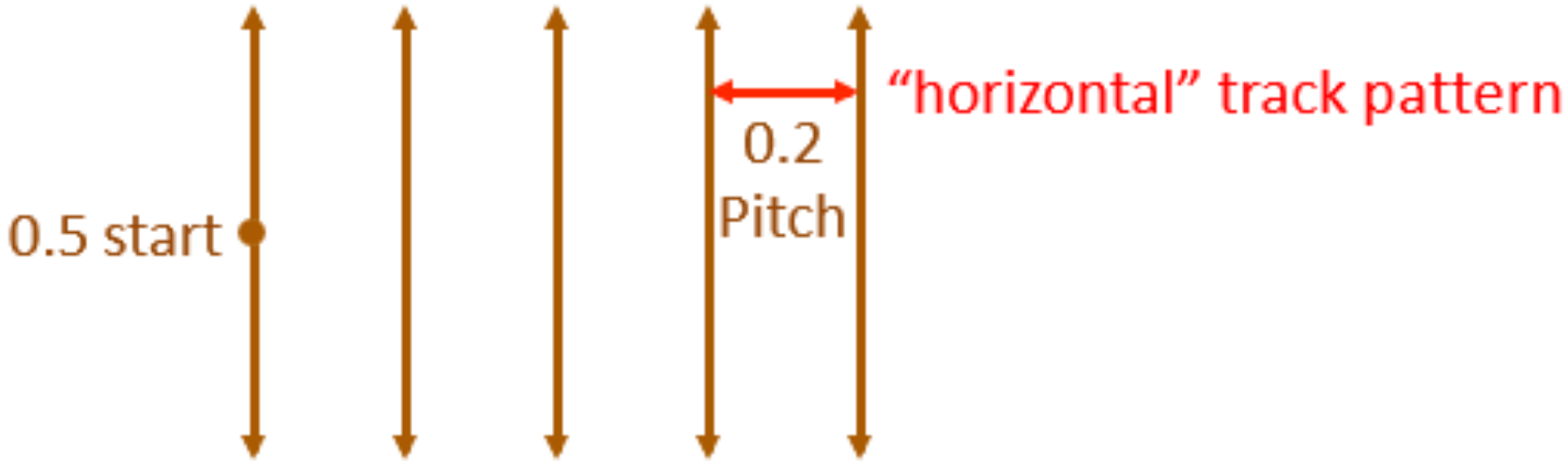
- A layer blockage can be used to block layers
  - Focus in training will be on “routing” blockages, but a few other layer blockage types exist (see oaBlockageType)
  - A routing blockage tells routers to not route in a given area

```
# Create a M2 routing blockage
m2 = oa.oaLayer.find(tech, "m2").getNumber()
blkpts = pts2dbu( [[0.0, 0.0], [0.0, 20.0], [10.0, 20.0], [10.0, 0.0]] )
m2blk = oa.oaLayerBlockage.create(block, 'routing', m2, blkpts)
```

oaTrackPattern (Simple)

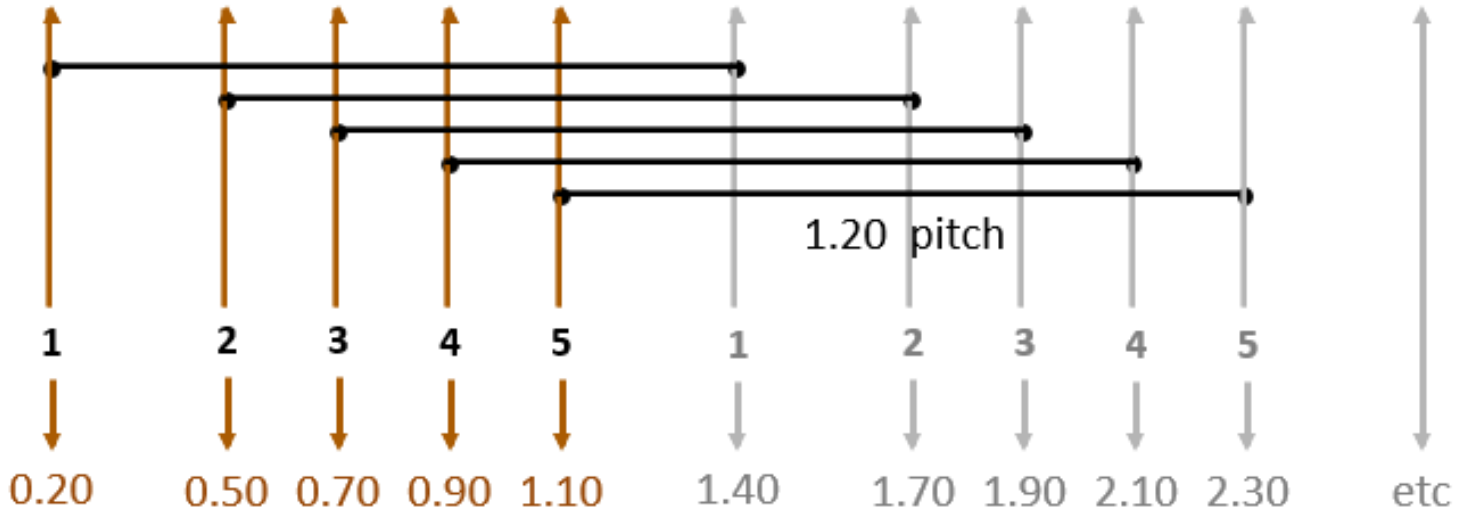
- An oaTrackPattern is a formula which specifies where routing on a given layer will go
- Trackpattern includes/excludes:
  - Includes: orientation (horiz/vert), layer, num tracks, begin point, pitch
  - Excludes: allowed width(s), expected wire net names, end points
- Orientation (horiz/vert) is in the **directon of the pitch (not the track orientation)**

```
m1 = oa.oaLayer.find(tech, "m1").getNumber() horiz = True
oa.oaTrackPattern.create(blk, horiz, cd2dbu(0.5), 5, cd2dbu(0.2), m1)
```



oaTrackPattern (Complex)

- Complex grids can be created by using multiple track patterns
- Need to calculate number of tracks to end at a certain point
- Example below:
  - Metal orientation will be vertical (so use “horizontal” track pattern)
  - Power/Ground track will use wider metal width and start the pattern at 0.20 offset from the origin (note metal width is not stored on Track Patterns)
  - Signal track will be at 0.50, 0.70, 0.90, 1.10
  - Entire pattern set repeats at 1.20 pitch



Calculating Number of oaTrackPattern Tracks

- There is no end location in oaTrackPatterns, instead the number of patterns is used to stop but must be calculated
- Example function on calculating number of tracks

```
def tpnum(begin, pitch, end):
# Calculate number of tracks to use given begin, pitch, end
num = int((end - begin) / pitch)
remain = (end - begin) - (num * pitch)
tot = num
if remain > sys.float_info.epsilon:
# add another tp for the remainder
tot += 1
if num > 0:
# num is number of pitches - add 1 since 2 tp in one pitch
tot += 1
return(tot)

# Note: Machine epsilon gives an upper bound on the relative error due to rounding in
   floating point arithmetic.
```

Finding Special Objects in an oaBlock

- Earlier, we found out that shapes can be queried using oaBlock::getShapes()
  - This will not return the special objects mentioned in this section
- Use the following to get the special objects mentioned in this section from an oaBlock:
  - oaPRBoundary::find
  - oaBlock::getBlockages (be sure to check the blockage type)
  - oaBlock::getTrackPatterns

Lab 8.1: Create OA Objects in an oaBlock

- Goal - Become familiar in working with oaPRBoundary, oaLayerBlockage, and oaTrackPattern objects

- Write a script to create oaBlock to hold special OA objects:
  1. Create layout oaDesign called “objects” under library “mylib”
  2. Create an oaPRBoundary with lower-left at 0,0 that is 10um square
  3. Create an oaLayerBlockage with lower-left at 0,0 that is 3um sqaure
  4. Create vertically oriented (“horizontal”) oaTrackPatterns for “m1” using the track pattern sequence on the “complex” track pattern slide and fit within the 10um square boundary

Compare your script to labs/8.1/objects.py

Section 8 Summary

- Learned about, and used, the oaPRBoundary object
- Demonstrated use of oaLayerBlockage object to block routing
- Explored oaTrackPattern object and how it is defined
- Discovered techniques for accessing these objects

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