

Structured input to HIJSON

Towards indoor mapping and IoT modeling *

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July 23, 2015

Abstract

This module aims to prototype the process of entering geometric data representing a complex building, to provide them explicit semantic and a hierarchical model. The generated LAR structures [DPS14, PDFJ15] are finally output to HIJSON format, an experimental data format extending GEOJSON for applications of indoor mapping and the Internet-of-Things. In HIJSON a strongly simplified building model, yet sufficient for useful purposes, accomodates the knowledge concerning the use models of the building and the set of interior devices and their connection.

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*This document is part of the *Linear Algebraic Representation with CoChains* (LAR-CC) framework [CL13]. July 23, 2015

1 Introduction

2 Implementation

2.1 Input of geometry from external drawings

File input and computation of cellular complex The modeling process starts with the input of a `.svg` file, the W3C standard for 2D vector graphics on the web. The file must only contain (by now) `<rect>` and `<line>` graphics primitives. The geometric data generate the partition of the plane induced by an arrangement of intersecting lines. The arrangement of (fragmented) lines is finally transformed into a 2D *LAR model*, made by the triple V, FV, EV of vertices, faces and edges. We notice the the LAR input is normalized by the `larFromLines` function: all vertices in V are transformed in the standard plane interval $[0, 1]^2$.

```
<SVG file input and computation of cellular complex 2a>  $\equiv$ 
    """ File input and computation of cellular complex """
    def svg2lar(filename):
        lines = svg2lines(filename)
        larModel = larFromLines(lines)
        V, FV, EV = larModel
        return larModel
     $\diamond$ 
```

Macro referenced in [6b](#).

2.2 Emulation of interactive graphics input

In this section two functions are given to emulate two graphics input primitives, respectively.

Emulation of input from “selection box” The function accepts as input the LAR model V, FV, EV and a `queryBox` given in normalized coordinates. It returns `vertexSubset` $\subseteq V$, `faceSubset` $\subseteq FV$, `edgeSubset` $\subseteq EV$.

```
<Emulation of input from “selection box” 2b>  $\equiv$ 

    """ Emulation of input from “selection box” over a LAR normalized representation """
    from scipy import spatial
    from bool import crossRelation, pointInPolygonClassification

    def subComplexInBox(V, FV, EV, queryBox):
        (xmin, ymin), (xmax, ymax) = queryBox
        if xmin > xmax: xmin, xmax = xmax, xmin
        if ymin > ymax: ymin, ymax = ymax, ymin
```

```

vdict = dict([(vcode(vert),k) for k,vert in enumerate(V)])
vertexSubset = [vdict[vcode((x,y))] for x,y in V if xmin<=x<=xmax and ymin<=y<=ymax]
edgeSubset = [e for e,edge in enumerate(EV) if all([v in vertexSubset for v in edge])]
faceSubset = [f for f,face in enumerate(FV) if all([v in vertexSubset for v in face])]
return vertexSubset,faceSubset,edgeSubset

if __name__=="__main__":
    selectBox = ((0.45, 0.45), (0.65, 0.75))
    vertexSubset,faceSubset,edgeSubset = subComplexInBox(V,FV,EV,selectBox)
    #VIEW(EXPLODE(1.2,1.2,1.2)(MKPOLLS((V,[EV[e] for e in edgeSubset])) + [
        #COLOR(RED)(MK(selectBox[0])), COLOR(RED)(MK(selectBox[1]))]))
    #VIEW(EXPLODE(1.2,1.2,1.2)(MKPOLLS((V,[FV[f] for f in faceSubset])) + [
        #COLOR(RED)(MK(selectBox[0])), COLOR(RED)(MK(selectBox[1]))]))

```

◇

Macro referenced in 6b.

Emulation of “pick” input over a LAR normalized representation The function accepts as input the LAR model V, FV, EV , the incidence relation FE , that provides for each face the list of incident edges, and a `queryPoint` given in normalized coordinates. It returns $vertexSubset \subseteq V$, $faceSubset \subseteq FV$, $edgeSubset \subseteq EV$.

⟨ Emulation of “pick” input 3a ⟩ ≡

```

""" Emulation of ‘pick’ input over a LAR normalized representation """
def subComplexAroundPoint(V,FV,EV,FE,queryPoint):
    tree = spatial.cKDTree(V)
    pts = np.array([queryPoint])
    dist,closestVertex = tree.query(pts)
    VF = invertRelation(FV)
    closestFaces = VF[closestVertex]
    for face in closestFaces:
        faceEdges = [EV[e] for e in FE[face]]
        if pointInPolygonClassification(queryPoint, (V,faceEdges)) == "p_in":
            break
    vertexSubset = FV[face]
    edgeSubset = [EV[e] for e in FE[face]]
    faceSubset = [face]
    return vertexSubset,faceSubset,edgeSubset

if __name__=="__main__":
    FE = crossRelation(FV,EV)
    queryPoint = (0.6,0.58)
    vertexSubset,faceSubset,edgeSubset = subComplexAroundPoint(V,FV,EV,FE,queryPoint)
    ##VIEW(EXPLODE(1.2,1.2,1.2)(MKPOLLS((V,[EV[e] for e in FE[faceSubset[0]]])) + [
        #COLOR(RED)(MK(queryPoint))]) )

```

◇

Macro referenced in 6b.

From LAR chain to colored HPCs The function `cells2hpcs` is used to assign a given `k` color to the cells of a chain (cell subset) of a LAR model `V,FV`. The function returns a list of HPC (colored) objects.

```

⟨From LAR chain to colored HPCs 3b⟩ ≡
    """ From LAR chain to colored HPCs """
    def cells2hpcs(V,FV,cells,k):
        colors = [RED, GREEN, BLUE, CYAN, MAGENTA, YELLOW, WHITE, PURPLE, BROWN]
        return AA(COLOR(colors[k]))(MKPOLs((V,[FV[f] for f in cells])))
    ◇

```

Macro referenced in [6b](#).

2.3 Structural operations

From 2D chains to boundary chains

```

⟨From 2D chains to boundary chains 4a⟩ ≡
    """ From 2D chains to boundary chains """
    def chain2BoundaryChain(FV,EV):
        csrBoundaryMat = boundary(FV,EV)
        nedges,nfaces = csrBoundaryMat.shape
        def chain2BoundaryChain0(chain):
            row = np.array(chain)
            col = np.array([0 for k in range(len(chain))])
            data = np.array([1 for k in range(len(chain))])
            csrFaceVect = scipy.sparse.coo_matrix((data, (row, col)), shape=(nfaces,1)).tocsr()
            csrEdgeVect = csrBoundaryMat*csrFaceVect
            boundaryChain = [h for h,val in
                zip(csrEdgeVect.tocoo().row, csrEdgeVect.tocoo().data) if val%2 != 0]
            return boundaryChain
        return chain2BoundaryChain0
    ◇

```

Macro referenced in [6b](#).

From chains to structures

```

⟨From chains to structures 4b⟩ ≡
    """ From chains to structures """
    def chain2structs(V,FV,EV,FE):
        def chain2structs0(args):
            if args == ([],[],[]): return
            chain,chainName,classtype = args
            struct = []
            for cell in chain:
                vs = [V[v] for v in FV[cell]]

```

```

        vdict = dict([[vcode(vert),k] for k,vert in enumerate(vs)])
        facetEdges = [[V[v] for v in EV[e]] for e in FE[cell]]
        ev = [(vdict[vcode(v1)], vdict[vcode(v2)]) for v1,v2 in facetEdges]
        fv = [range(len(vs))]
        shape = vs,fv,ev
        struct += [ Struct([ shape ], name=None, category="room" ) ]
        out = Struct( struct, name=chainName, category=classtype )
        return out
    return chain2structs0

```

◇

Macro referenced in 6b.

From LAR oriented boundary model to polylines

```

⟨ From LAR boundary model to polylines 5a ⟩ ≡
    """ From LAR oriented boundary model to polylines """
    def boundaryModel2polylines(model):
        V,EV = model
        ##VIEW(STRUCT(MKPOLS((V,EV))))
        #import pdb; pdb.set_trace()
        polylines = []
        succDict = dict(EV)
        visited = [False for k in range(len(V))]
        nonVisited = [k for k in succDict.keys() if not visited[k]]
        while nonVisited != []:
            first = nonVisited[0]; v = first; polyline = []
            while visited[v] == False:
                visited[v] = True;
                polyline += V[v],
                v = succDict[v]
            polyline += [V[first]]
            polylines += [polyline]
            nonVisited = [k for k in succDict.keys() if not visited[k]]
        return polylines

```

◇

Macro referenced in 6b.

From Struct object to LAR boundary model

```

⟨ From Struct object to LAR boundary model 5b ⟩ ≡
    """ From Struct object to LAR boundary model """
    def structFilter(obj):
        if isinstance(obj,list):
            if (len(obj) > 1):
                return [structFilter(obj[0])] + structFilter(obj[1:])

```

```

        return [structFilter(obj[0])]
    if isinstance(obj, Struct):
        if obj.category in ["external_wall", "internal_wall", "corridor_wall"]:
            return
        return Struct(structFilter(obj.body), obj.name, obj.category)
    return obj

def structBoundaryModel(struct):
    print ">> struct =", struct
    filteredStruct = structFilter(struct)
    print ">> filteredStruct =", filteredStruct
    #import pdb; pdb.set_trace()
    V, FV, EV = struct2lar(filteredStruct)
    edgeBoundary = boundaryCells(FV, EV)
    cycles = boundaryCycles(edgeBoundary, EV)
    edges = [signedEdge for cycle in cycles for signedEdge in cycle]
    orientedBoundary = [ AA(SIGN)(edges), AA(ABS)(edges)]
    cells = [EV[e] if sign==1 else REVERSE(EV[e]) for (sign,e) in zip(*orientedBoundary)]
    if cells[0][0]==cells[1][0]: # bug badly patched! ... TODO better
        temp0 = cells[0][0]
        temp1 = cells[0][1]
        cells[0] = [temp1, temp0]
    return V, cells

```

◇

Macro referenced in 6b.

From structures to boundary polylines

```

⟨From structures to boundary polylines 6a⟩ ≡
    """ From structures to boundary polylines """
    def boundaryPolylines(struct):
        V, boundaryEdges = structBoundaryModel(struct)
        polylines = boundaryModel2polylines((V, boundaryEdges))
        return polylines

```

◇

Macro referenced in 6b.

3 Exporting the library

```

"lib/py/hijson.py" 6b ≡
    """ Module for Structured input to HIJSON """
    from pyplasm import *
    """ import modules from larcc/lib """
    import sys

```

```

sys.path.insert(0, 'lib/py/')
from inters import *
from larcc import *
from bool import *
from iot3d import *
from copy import copy
DEBUG = False

⟨SVG file input and computation of cellular complex 2a⟩
⟨Emulation of input from “selection box” 2b⟩
⟨Emulation of “pick” input 3a⟩
⟨From LAR chain to colored HPCs 3b⟩
⟨From 2D chains to boundary chains 4a⟩
⟨From chains to structures 4b⟩
⟨From Struct object to LAR boundary model 5b⟩
⟨From LAR boundary model to polylines 5a⟩
⟨From structures to boundary polylines 6a⟩
◇

```

4 Test examples

4.1 Example of a complex building model: part definition

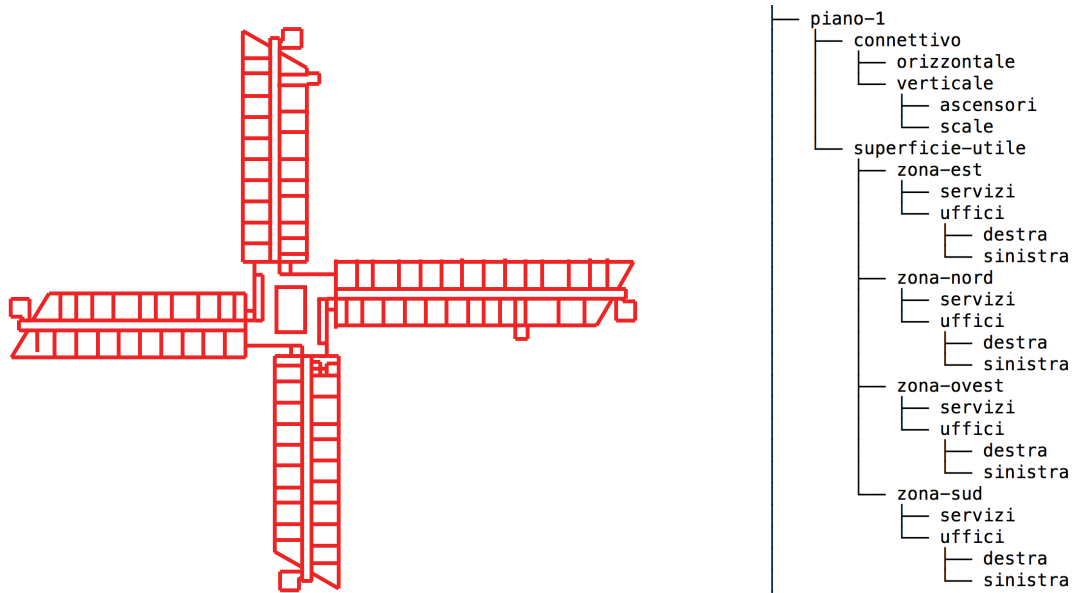


Figure 1: The input SVG drawing of the typical floor layout.

Visualization of cell numbering in a 2D complex

⟨ Visualization of cell numbering in a 2D complex 7 ⟩ ≡

```
""" Visualization of cell numbering in a 2D complex """
VV = AA(LIST)(range(len(V)))
submodel = STRUCT(MKPOLS((V,EV)))
#VIEW(larModelNumbering(1,1,1)(V,[VV,EV,FV[:-1]],submodel,2.5))
◇
```

Macro referenced in 12b.

Ala nord (HPCs)

⟨ Ala nord 8a ⟩ ≡

```
FE = crossRelation(FV,EV)
chainsToStruct = chain2structs(V,FV,EV,FE)

""" Ala nord """
boxes = [0 for k in range(64)]
point = [0 for k in range(64)]
boxes[0] = array([[0.431, 0.607], [0.474, 0.91]])*scaleFactor #[V[k] for k in [39,208]]
boxes[1] = array([[0.416, 0.657], [0.372, 0.953]])*scaleFactor #[V[k] for k in [162,39]]
boxes[2] = array([[0.416, 0.627], [0.431, 0.986]])*scaleFactor #[V[k] for k in [206,247]]
boxes[3] = array([[0.431, 0.607], [0.448, 0.627]])*scaleFactor #[V[k] for k in [39,7]]
boxes[4] = array([[0.431, 0.91], [0.494, 0.929]])*scaleFactor #[V[k] for k in [213,234]]
boxes[5] = array([[0.431, 0.97], [0.466, 1.0]])*scaleFactor #[V[k] for k in [58,88]]
boxes[27] = array([[0.416, 0.627], [0.372, 0.657]])*scaleFactor #[V[k] for k in [110,82]]

point[0] = array([0.394, 0.9625])*scaleFactor #CCOMB([V[k] for k in [190,197]])
point[1] = array([0.4525, 0.9325])*scaleFactor #CCOMB([V[k] for k in [166,159]])

piano1_superficieUtile_zonaNord_uffici_destra = subComplexInBox(V,FV,EV,boxes[0])[1]
piano1_superficieUtile_zonaNord_uffici_sinistra = subComplexInBox(V,FV,EV,boxes[1])[1]
piano1_connettivo_orizzontale_zonaNord = subComplexInBox(V,FV,EV,boxes[2])[1]
piano1_connettivo_verticale_zonaNord_ascensore = subComplexInBox(V,FV,EV,boxes[3])[1]
piano1_connettivo_verticale_zonaNord_ascensore += subComplexInBox(V,FV,EV,boxes[4])[1]
piano1_connettivo_verticale_zonaNord_scale = subComplexInBox(V,FV,EV,boxes[5])[1]
piano1_superficieUtile_zonaNord_servizi = subComplexAroundPoint(V,FV,EV,FE,point[0])[1]
piano1_superficieUtile_zonaNord_servizi += subComplexAroundPoint(V,FV,EV,FE,point[1])[1]
piano1_superficieUtile_zonaNord_servizi += subComplexInBox(V,FV,EV,boxes[27])[1]

piano1N = [piano1_superficieUtile_zonaNord_uffici_destra, piano1_superficieUtile_zonaNord_uffici_sinistra]
◇
```

Macro defined by 8ab.

Macro referenced in 12b.

⟨ Ala nord 8b ⟩ ≡


```

"" Ala nord ""
piano1N_nomi = ["piano1_superficieUtile_zonaNord_uffici_destra", "piano1_superficieUtile_zonaNord_uffici_sinistra"]
piano1N_categorie = ["uffici","uffici","corridoi","ascensori","scale","servizi"]
p1N = zip(piano1N,piano1N_nomi,piano1N_categorie)
piano1_zonaNord = Struct(AA(chainsToStruct)(p1N),"piano1_zonaNord","ala")
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_zonaNord))))))

nord = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano1N)])
#VIEW(EXPLODE(1.2,1.2,1.2)(nord))
◇

```

Macro defined by [8ab](#).
Macro referenced in [12b](#).

Ala est (HPCs)

⟨Ala est 9a⟩ ≡

```

"" Ala est ""
boxes[6] = array([[0.019, 0.533], [0.376, 0.577]])*scaleFactor #[V[k] for k in [241,29]]
boxes[7] = array([[0.07, 0.474], [0.343, 0.518]])*scaleFactor #[V[k] for k in [264,148]]
boxes[8] = array([[0.013, 0.518], [0.376, 0.533]])*scaleFactor #[V[k] for k in [22,63]]
boxes[9] = array([[0.376, 0.533], [0.39, 0.549]])*scaleFactor #[V[k] for k in [63,92]]
boxes[10] = array([[0.001, 0.474], [0.07, 0.518]])*scaleFactor #[V[k] for k in [263,265]]
boxes[11] = array([[0.343, 0.474], [0.376, 0.518]])*scaleFactor #[V[k] for k in [84,149]]

point[2] = array([0.015, 0.5535])*scaleFactor #CCOMB([V[k] for k in [228,14]])

piano1_superficieUtile_zonaEst_uffici_destra = subComplexInBox(V,FV,EV,boxes[6])[1]
piano1_superficieUtile_zonaEst_uffici_sinistra = subComplexInBox(V,FV,EV,boxes[7])[1]
piano1_connettivo_orizzontale_zonaEst = subComplexInBox(V,FV,EV,boxes[8])[1]
piano1_connettivo_verticale_zonaEst_ascensore = subComplexInBox(V,FV,EV,boxes[9])[1]
piano1_connettivo_verticale_zonaEst_scale = subComplexAroundPoint(V,FV,EV,FE,point[2])[1]
piano1_superficieUtile_zonaEst_servizi = subComplexInBox(V,FV,EV,boxes[10])[1]
piano1_superficieUtile_zonaEst_servizi += subComplexInBox(V,FV,EV,boxes[11])[1]

piano1E = [piano1_superficieUtile_zonaEst_uffici_destra, piano1_superficieUtile_zonaEst_uffici_sinistra]
◇

```

Macro defined by [9ab](#).
Macro referenced in [12b](#).

⟨Ala est 9b⟩ ≡

```

"" Ala est ""
piano1E_nomi = ["piano1_superficieUtile_zonaEst_uffici_destra", "piano1_superficieUtile_zonaEst_uffici_sinistra"]
piano1E_categorie = ["uffici","uffici","corridoi","ascensori","scale","servizi"]
p1E = zip(piano1E,piano1E_nomi,piano1E_categorie)
piano1_zonaEst = Struct(AA(chainsToStruct)(p1E), "piano1_zonaEst", "ala")
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_zonaEst))))))

```

```

est = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano1E)])
#VIEW(EXPLODE(1.2,1.2,1.2)(est + nord))
◇

```

Macro defined by 9ab.
Macro referenced in 12b.

Ala sud (HPCs)

⟨ Ala sud 9c ⟩ ≡

```

""" Ala sud """
boxes[12] = array([[0.467, 0.138], [0.423, 0.476]])*scaleFactor #[V[k] for k in [252,47]]
boxes[13] = array([[0.482, 0.145], [0.525, 0.445]])*scaleFactor #[V[k] for k in [241,126]]
boxes[14] = array([[0.482, 0.476], [0.467, 0.116]])*scaleFactor #[V[k] for k in [254,232]]
boxes[15] = array([[0.449, 0.476], [0.467, 0.493]])*scaleFactor #[V[k] for k in [40,237]]
boxes[16] = array([[0.431, 0.101], [0.467, 0.131]])*scaleFactor #[V[k] for k in [259,2]]
boxes[17] = array([[0.482, 0.445], [0.525, 0.476]])*scaleFactor #[V[k] for k in [155,248]]
boxes[18] = array([[0.525, 0.104], [0.482, 0.145]])*scaleFactor #[V[k] for k in [111,241]]

piano1_superficieUtile_zonaSud_uffici_destra = subComplexInBox(V,FV,EV,boxes[12])[1]
piano1_superficieUtile_zonaSud_uffici_sinistra = subComplexInBox(V,FV,EV,boxes[13])[1]
piano1_connettivo_orizzontale_zonaSud = subComplexInBox(V,FV,EV,boxes[14])[1]
piano1_connettivo_verticale_zonaSud_ascensore = subComplexInBox(V,FV,EV,boxes[15])[1]
piano1_connettivo_verticale_zonaSud_scale = subComplexInBox(V,FV,EV,boxes[16])[1]
piano1_superficieUtile_zonaSud_servizi = subComplexInBox(V,FV,EV,boxes[17])[1]
piano1_superficieUtile_zonaSud_servizi += subComplexInBox(V,FV,EV,boxes[18])[1]

piano1S = [piano1_superficieUtile_zonaSud_uffici_destra, piano1_superficieUtile_zonaSud_uffici.
◇

```

Macro defined by 9c, 10a.
Macro referenced in 12b.

⟨ Ala sud 10a ⟩ ≡

```

""" Ala sud """
piano1S_nomi = ["piano1_superficieUtile_zonaSud_uffici_destra", "piano1_superficieUtile_zonaSu
piano1S_categorie = ["uffici","uffici","corridoi","ascensori","scale","servizi"]
p1S = zip(piano1S,piano1S_nomi, piano1S_categorie)
piano1_zonaSud = Struct(AA(chainsToStruct)(p1S), "piano1_zonaSud", "ala")
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_zonaSud))))))

sud = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano1S)])
#VIEW(EXPLODE(1.2,1.2,1.2)(est + nord + sud))
◇

```

Macro defined by 9c, 10a.
Macro referenced in 12b.

Ala ovest (HPCs)

⟨Ala ovest 10b⟩ ≡

```
""" Ala ovest """
boxes[19] = array([[0.521, 0.526], [0.963, 0.568]])*scaleFactor #[V[k] for k in [169,202]]
boxes[20] = array([[0.555, 0.584], [0.955, 0.627]])*scaleFactor #[V[k] for k in [12,23]]
boxes[21] = array([[0.521, 0.568], [0.985, 0.584]])*scaleFactor #[V[k] for k in [209,204]]
boxes[22] = array([[0.506, 0.551], [0.521, 0.568]])*scaleFactor #[V[k] for k in [89,209]]
boxes[23] = array([[0.808, 0.504], [0.828, 0.526]])*scaleFactor #[V[k] for k in [270,77]]
boxes[24] = array([[0.955, 0.584], [0.997, 0.627]])*scaleFactor #[V[k] for k in [220,24]]
boxes[25] = array([[0.521, 0.584], [0.555, 0.627]])*scaleFactor #[V[k] for k in [11,144]]
boxes[26] = array([[1.0, 0.533], [0.97, 0.568]])*scaleFactor #[V[k] for k in [233,201]]

piano1_superficieUtile_zonaOvest_uffici_destra = subComplexInBox(V,FV,EV,boxes[19])[1]
piano1_superficieUtile_zonaOvest_uffici_sinistra = subComplexInBox(V,FV,EV,boxes[20])[1]
piano1_connettivo_orizzontale_zonaOvest = subComplexInBox(V,FV,EV,boxes[21])[1]
piano1_connettivo_verticale_zonaOvest_ascensore = subComplexInBox(V,FV,EV,boxes[22])[1]
piano1_connettivo_verticale_zonaOvest_ascensore += subComplexInBox(V,FV,EV,boxes[23])[1]
piano1_superficieUtile_zonaOvest_servizi = subComplexInBox(V,FV,EV,boxes[24])[1]
piano1_superficieUtile_zonaOvest_servizi += subComplexInBox(V,FV,EV,boxes[25])[1]
piano1_connettivo_verticale_zonaOvest_scale = subComplexInBox(V,FV,EV,boxes[26])[1]

piano10 = [piano1_superficieUtile_zonaOvest_uffici_destra, piano1_superficieUtile_zonaOvest_uf.
◇
```

Macro defined by 10b, 11a.

Macro referenced in 12b.

⟨Ala ovest 11a⟩ ≡

```
""" Ala ovest """
piano10_nomi = ["piano1_superficieUtile_zonaOvest_uffici_destra", "piano1_superficieUtile_zonaOvest_uffici_sinistra"]
piano10_categorie = ["uffici","uffici","corridoi","ascensori","scale","servizi"]
p10 = zip(piano10,piano10_nomi, piano10_categorie)
piano1_zonaOvest = Struct(AA(chainsToStruct)(p10), "piano1_zonaOvest", "ala")
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_zonaOvest))))))

ovest = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano10)])
#VIEW(EXPLODE(1.2,1.2,1.2)(est + nord + sud + ovest))
◇
```

Macro defined by 10b, 11a.

Macro referenced in 12b.

Centro stella (HPCs)

⟨Centro stella 11b⟩ ≡

```

    """ Centro stella """
    piano1_connettivo_orizzontale_centroStella = [2]
    piano1_connettivo_verticale_centroStella_scale = [15,26]

    piano1C = [[],[],piano1_connettivo_orizzontale_centroStella,[], piano1_connettivo_verticale_centroStella_scale]
    centro = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano1C)])
    ◇

```

Macro defined by [11bc](#).
Macro referenced in [12b](#).

⟨ Centro stella 11c ⟩ ≡

```

    """ Centro stella """
    piano1C_nomi = [[],[],"piano1_connettivo_orizzontale_centroStella", [], "piano1_connettivo_verticale_centroStella_scale"]
    piano1C_categorie = [[],[],"corridoi",[], "ascensori"]
    p1C = zip(piano1C_nomi,piano1C_categorie)
    piano1_centroStella = Struct(AA(chainsToStruct)(p1C), "piano1_centroStella", "centro")
    #VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_centroStella))))))

    #VIEW(EXPLODE(1.2,1.2,1.2)(est + nord + sud + ovest + centro))
    #VIEW(STRUCT(est + nord + sud + ovest + centro))
    ◇

```

Macro defined by [11bc](#).
Macro referenced in [12b](#).

4.2 Example of a complex building model: integration

Assembly of parts (HPCs)

⟨ Assemblaggio 12a ⟩ ≡

```

    """ Assemblaggio """
    p1 = p1N + p1S + p1E + p1O + p1C

    piano1_nomi = ["piano1_zonaNord", "piano1_zonaEst", "piano1_zonaSud", "piano1_zonaOvest", "piano1_centro"]
    piano1_categorie = ["ala","ala","ala","ala","centro"]
    piano1 = Struct(AA(chainsToStruct)(p1), "piano1", "level")

    #VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1))))))

    V,boundaryEdges = structBoundaryModel(piano1)
    drawing = mkSignedEdges((V,boundaryEdges))
    #VIEW(drawing)

    polylines = boundaryModel2polylines((V,boundaryEdges))
    #VIEW(STRUCT(AA(POLYLINE)(polylines)))

    print boundaryPolylines(piano1)
    ◇

```

Macro referenced in [12b](#).

Assembling floor layout generation

```
< Assembling floor layout generation 12b > ≡  
    """ Assembling floor layout generation """  
    < Visualization of cell numbering in a 2D complex 7 >  
    < Ala nord 8a, ... >  
    < Ala est 9a, ... >  
    < Ala sud 9c, ... >  
    < Ala ovest 10b, ... >  
    < Centro stella 11b, ... >  
    < Assemblaggio 12a >  
    ◇
```

Macro referenced in 13bc.

```
< Tower example initialization 13a > ≡  
    """ make the model of a layout floor """  
    """ import modules from larcc/lib """  
    import sys  
    sys.path.insert(0, 'lib/py/')  
    from hijson import *  
  
    scaleFactor = 83.333  
  
    filename = "test/py/inters/plan.svg"  
    larModel = svg2lar(filename)  
    larModel = larApply(s(scaleFactor,scaleFactor))(larModel)  
    V,FV,EV = larModel  
    FV[2] += FV[71]      # for now :o)  
    ◇
```

Macro referenced in 13bc.

```
"test/py/hijson/test01.py" 13b ≡  
    """ make the model of a layout floor """  
    < Tower example initialization 13a >  
    < Assembling floor layout generation 12b >  
  
    primoPiano = AA(list)([CAT(AA(S1)(p1N)),CAT(AA(S1)(p1E)),CAT(AA(S1)(p1S)),  
                           CAT(AA(S1)(p1O)),CAT(AA(S1)(p1C))])  
    primoPiano_nomi = ["piano1_zonaNord","piano1_zonaEst","piano1_zonaSud","piano1_zonaOvest","piano1_zonaCentro"]  
    primoPiano_categorie = ["ala","ala","ala","ala","centro"]  
    pianoPrimo = zip(primoPiano, primoPiano_nomi, primoPiano_categorie)  
    piano_1 = Struct( AA(chainsToStruct)(pianoPrimo), "piano1", "level" )  
    import iot3d  
  
    piano_1_3D = embedStruct(1)(piano_1,"3D")  
    iot3d.printStruct2GeoJson("./",piano_1_3D)
```

```

print "piano_1_3D =",piano_1_3D.category
print "piano_1_3D.body[0] =",piano_1_3D.body[0].category
print "piano_1_3D.body[0].body[0] =",piano_1_3D.body[0].body[0].category
◇

"test/py/hijson/test02.py" 13c ≡
    """ make the 2.5 model of a building tower """
    ⟨ Tower example initialization 13a ⟩
    ⟨ Assembling floor layout generation 12b ⟩

    pianoNord3D = embedStruct(1)(piano1_zonaNord,"3D")
    pianoEst3D = embedStruct(1)(piano1_zonaEst,"3D")
    pianoSud3D = embedStruct(1)(piano1_zonaSud,"3D")
    pianoOvest3D = embedStruct(1)(piano1_zonaOvest,"3D")
    pianoCentro3D = embedStruct(1)(piano1_centroStella,"3D")
    torreNord = Struct(4*[pianoNord3D,t(0,0,3)], "torreNord", "edificio")
    torreEst = Struct(7*[pianoEst3D,t(0,0,3)], "torreEst", "edificio")
    torreSud = Struct(7*[pianoSud3D,t(0,0,3)], "torreSud", "edificio")
    torreOvest = Struct(7*[pianoOvest3D,t(0,0,3)], "torreOvest", "edificio")
    torreCentro = Struct(7*[pianoCentro3D,t(0,0,3)], "torreCentro", "edificio")
    torre = Struct([torreNord,torreEst,torreSud,torreOvest,torreCentro],"torre", "edificio")
    V,FV,EV = struct2lar(torre)
    #VIEW(EXPLODE(1.2,1.2,1.2)(MKPOLs((V,EV))))
    #VIEW(STRUCT(MKPOLs((V,FV))))
    ◇

```

References

- [CL13] CVD-Lab, *Linear algebraic representation*, Tech. Report 13-00, Roma Tre University, October 2013.
- [DPS14] Antonio DiCarlo, Alberto Paoluzzi, and Vadim Shapiro, *Linear algebraic representation for topological structures*, Comput. Aided Des. **46** (2014), 269–274.
- [PDFJ15] Alberto Paoluzzi, Antonio DiCarlo, Francesco Furiani, and Miroslav Jirik, *Cad models from medical images using lar*, Computer-Aided Design and Applications **13** (2015), To appear.