

부 록

자연채광에 대한 검증

축소모형실험

대상공간의 주요 Scene(*.rad) 파일

재료특성 입력파일

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강의실의 주요 Scene(*.rad) 파일

재료특성 입력파일

담천공을 모델링하기 위한 Scene(*.rad) 파일

인공조명에 대한 검증

실내조명

인공조명을 모델링하기 위한 IES, DAT, RAD 파일

형광등의 형태를 지정한 Scene(*.rad) 파일

외부 야간경관조명

KOSMO Tower의 주요 Scene(*.rad) 파일

재료특성 입력파일

인공조명을 모델링하기 위한 IES, DAT, RAD 파일

자연채광에 대한 검증

축소모형실험

대상공간의 주요 Scene(*.rad) 파일

```
# box.rad  
#  
##
```

```
ceiling_mat polygon ceiling  
0  
0  
12  
    0.0  0.0  3.0  
    1.77636e-015  6.0  3.0  
    6.0  6.0  3.0  
    6.0  -1.77636e-015  3.0
```

```
wall_mat polygon wall_s  
0  
0  
12  
    3.0  -1.77636e-015  3.0  
    6.0  -1.77636e-015  3.0  
    6.0  -1.77636e-015  0.0  
    3.0  -1.77636e-015  0.0
```

```
floor_mat polygon floor  
0  
0  
12  
    1.77636e-015  6.0  0.0  
    0.0  0.0  0.0  
    6.0  -1.77636e-015  0.0  
    6.0  6.0  0.0
```

```
wall_mat polygon wall-n  
0
```

재료특성 입력파일

```
### box.mat
#
# this is box material

void plastic wall_mat
0
0
5 .5 .5 .5 .04139 .1

void plastic floor_mat
0
0
5 .8 .8 .8 .02543 .1

void plastic ceiling_mat
0
0
5 .2 .2 .2 .06229 .1
```

Sky 파일의 일례(3/21 12:00)

```
### sky312.rad
#
# creates a daytime sky and sky_illum

# 03/21 at 12:00 am Seoul, Korea.
# First day & peak time of spring!
!gensky 3 21 12.0 -a 37.5 -o 127.5 -m 135 +s

skyfunc glow skyglow
0
0
4 .8 .8 1 0

skyglow source sky
0
0
4 0 0 1 360

# procedure for mapping sky luminance to the
# invisible material illum. The data in
# skyfunc is created by gensky.

skyfunc brightfunc winbright
2 winxmit winxmit.cal
0
0

winbright illum sky_illum
0
0
3 .88 .88 .98

# end sky312.rad
```

실제 공간에서의 측정

강의실의 주요 Scene(*.rad) 파일

204.rad

##

LFRM polygon poly_1

0

0

12

11.9529	-11.0027	2.65219
11.9705	-11.0373	2.63
11.9655	-11.0274	2.64664
11.9529	-11.0027	2.65219

ROOV polygon poly_2

0

0

12

11.9529	-11.0027	2.65219
11.9655	-11.0274	2.64664
11.9705	-11.0373	2.63
11.9529	-11.0027	2.65219

LFRM polygon poly_3

0

0

12

10.5719	-11.7064	2.65219
10.5895	-11.741	2.63
10.5844	-11.7311	2.64664
10.5719	-11.7064	2.65219

ROOV polygon poly_4

0

0

12

10.5719	-11.7064	2.65219
10.5844	-11.7311	2.64664
10.5895	-11.741	2.63
10.5719	-11.7064	2.65219

LFRM polygon poly_5

0

0

12

10.5719	-11.7064	2.65219
10.5844	-11.7311	2.64664
11.9655	-11.0274	2.64664
11.9529	-11.0027	2.65219

LFRM polygon poly_6

0

0

12

10.5844	-11.7311	2.64664
10.5895	-11.741	2.63
11.9705	-11.0373	2.63
11.9655	-11.0274	2.64664

ROOV polygon poly_7

0

0

12

10.5895	-11.741	2.63
10.5844	-11.7311	2.64664
11.9655	-11.0274	2.64664
11.9705	-11.0373	2.63

ROOV polygon poly_8

0

0

12

11.9529	-11.0027	2.65219
11.9655	-11.0274	2.64664
10.5844	-11.7311	2.64664
10.5719	-11.7064	2.65219

LFRM polygon poly_9

0

0

12

11.9378	-10.9731	2.63
11.9403	-10.978	2.58562

재료특성 입력파일

```
### 204.mat
#
## this is the material of 204 room.

# black board with black matte
void plastic BRD
0
0
5 0 .017 .017 .1610 .05

# ceiling plane with white matte board
#void colorpict CEIL
#9 clip_r clip_g clip_b c.pic picture.cal tile_u tile_v -s 10
#0
#1 1.48
void plastic CEIL
0
0
5 .95 .95 .95 .1068 .05

# door with blue matte finish
void plastic DOR
0
0
5 .0 .0 .119 .07 .05

# floor with using picfile
#void colorpict FLOR
#9 clip_r clip_g clip_b f.pic picture.cal tile_u tile_v -s 10
#0
#1 1.48
void plastic FLOR
0
0
5 .3 .3 .3 .2637 .05
```

```
# this is the material of glass
```

```
void glass GLAS
```

```
0
```

```
0
```

```
3 .96 .96 .96
```

```
# radiator with specular and matte finish
```

```
void metal HEAT
```

```
0
```

```
0
```

```
5 .5 .5 .5 .75 .1
```

```
# lighting's frame with white matte
```

```
void plastic LFRM
```

```
0
```

```
0
```

```
5 .78 .78 .78 .025 .0
```

```
# this is the roover of fornt-lighting
```

```
void plastic ROOV
```

```
0
```

```
0
```

```
5 .6 .6 .6 .55 .1
```

```
# this is the material of glass
```

```
void plastic WAL
```

```
0
```

```
0
```

```
5 .255 .255 .204 .8457 .05
```

```
# this is the material of window bar
```

```
#void colorpict WBAR
```

```
#11 .55 .55 .55 floor.pic picture.cal pic_u pic_v -s 10
```

```
#0
```

```
#1 1.48
```

```
void plastic WBAR
```

```
0
```

```
0
```

```
5 .55 .55 .5 0 0
```



```
# window frame with specular finish
```

```
void metal WFRM
```

```
0
```

```
0
```

```
5 .6 .6 .6 .55 .1
```

```
# window glass frame
```

```
void metal WIN
```

```
0
```

```
0
```

```
5 .6 .6 .6 .55 .1
```

```
# maple wood tile with waxed finish
```

```
void brightfunc mottled
```

```
4 dirt dirt.cal -s .01
```

```
0
```

```
1 .30
```

```
mottled brightfunc maple
```

```
6 zgrain woodpat.cal -s .04 -ry 90
```

```
0
```

```
1 .55
```

```
maple texfunc grainy
```

```
6 xgrain_dx ygrain_dx zgrain_dx woodtex.cal -s .005
```

```
0
```

```
1 .075
```

```
grainy plastic WOD
```

```
0
```

```
0
```

```
5 .102 .071 .005 .1024 .05
```

```
# this is the material of wood window frame
```

```
grainy plastic WODF
```

```
0
```

```
0
```

```
5 .102 .071 .005 .1024 .05
```

```
# this is the material of wood window glass frame
grainy plastic WODW
0
0
5 .102 .071 .005 .1024 .05
```

```
# this is the material of glass with back wood
grainy plastic GLAS-WOD
0
0
5 .789 .411 .198 .5 .0
```

담천공을 모델링하기 위한 Scene(*.rad) 파일

```
#sky_o3000.rad
#CIE overcast sky (Horizontal illuminance: 3000LUX)
#Ground reflectance: 0.1

!gensky 1 1 1 -c -b 16.7597765363128491620 -g 0.1

skyfunc glow sky_glow
0
0
4 1 1 1 0

sky_glow source sky
0
0
4 0 0 1 180

skyfunc glow ground_glow
0
0
4 1 1 1 0

ground_glow source ground
0
0
4 0 0 -1 180
```

인공조명에 대한 검증

실내조명

인공조명을 모델링하기 위한 IES, DAT, RAD 파일

```
IES , BILATERAL BATWING DISTRIBUTION-LOUVERED FLUORESCENT UNIT
LAMP=FLUORESCENT
TILT=NONE
  1  1000. 1.0 21  1 1 1  .83  4.00  0.00
1.0 1.0  40.
  .00  5.00  15.00  25.00  35.00  45.00  55.00  65.00  75.00  85.00
90.00  95.00 105.00 115.00 125.00 135.00 145.00 155.00
165.00 175.00 180.00
  .00
  1970.0  1970.0  1960.0  1990.0  1235.0  1223.0  990.5
80.5  60.0  45.5  .0  .0  0.0  .0
  0.0  0.0  0.0  0.0  0.0  0.0  0.0
```

```

# ies2rad -t white
# Dimensions in meters
#<IES #44, BILATERAL BATWING DISTRIBUTION-LOUVERED
FLUORESCENT UNIT
#<LAMP=FLUORESCENT
# 40 watt luminaire, lamp*ballast factor = 1

```

```

void brightdata ies44_dist
4 boxcorr ies44.dat source.cal src_theta
0
4 1 1.2192 0.252984 0.0005

```

```

ies44_dist light ies44_light
0
0
3 1 1 1

```

```

ies44_light polygon ies44.d
0
0
12
      -0.6096 -0.126492    -0.00025
      -0.6096 0.126492    -0.00025
      0.6096  0.126492    -0.00025
      0.6096  -0.126492   -0.00025

```

```

ies44_light polygon ies44.u
0
0
12
      -0.6096 -0.126492    0.00025
      0.6096  -0.126492    0.00025
      0.6096  0.126492     0.00025
      -0.6096 0.126492     0.00025

```

```
# ies.dat
#
##
```

```
1
0 0 21
```

```
0      5      15      25
35     45     55     65
75     85     90     95
105    115    125    135
145    155    165    175
180
```

```
11.0056 11.0056 10.9497 11.1173
6.89944 6.8324  5.53352 0.449721
0.335196      0.25419 0      0
0      0      0      0
0      0      0      0
0
```

형광등의 형태를 지정한 Scene(*.rad) 파일

```
# lighting.rad
#
##

ies44_light cylinder flu1-1
0
0
7 11.5109 -8.7475 2.7550
  12.1011 -9.9058 2.7550
  0.015

ies44_light cylinder flu1-2
0
0
7 11.4441 -8.7816 2.7550
  12.0342 -9.9399 2.7550
  0.015

ies44_light cylinder flu1-3
0
0
7 11.3772 -8.8156 2.7550
  11.9674 -9.9739 2.7550
  0.015

ies44_light cylinder flu2-1
0
0
7 9.3279 -9.8598 2.7550
  9.9181 -11.0181 2.7550
  0.015

ies44_light cylinder flu2-2
0
0
7 9.2611 -9.8939 2.7550
  9.8513 -11.0522 2.7550
  0.015

ies44_light cylinder flu2-3
```

0
0
7 9.1943 -9.9279 2.7550
9.7845 -11.0862 2.7550
0.015

ies44_light cylinder flu3-1
0
0
7 7.1450 -10.9721 2.7550
7.7351 -12.1304 2.7550
0.015

ies44_light cylinder flu3-2
0
0
7 7.0781 -11.0061 2.7550
7.6683 -12.1644 2.7550
0.015

ies44_light cylinder flu3-3
0
0
7 7.0113 -11.0402 2.7550
7.6015 -12.1985 2.7550
0.015

ies44_light cylinder flu4-1
0
0
7 9.8311 -5.4508 2.7550
10.4213 -6.6091 2.7550
0.015

ies44_light cylinder flu4-2
0
0
7 9.7643 -5.4848 2.7550
10.3545 -6.6432 2.7550
0.015

외부 야간경관조명

KOSMO Tower의 주요 Scene(*.rad) 파일

```
# kosmo.rad  
#  
##
```

```
GLAS1 polygon poly_1  
0  
0  
12  
    61.9437  41.5  102.242  
    61.796   41.5  101.5  
    63.736   41.5  101.5  
    63.736   41.5  101.5
```

```
GLAS1 polygon poly_2  
0  
0  
12  
    61.796   41.5  101.5  
    61.9437  41.5  100.758  
    63.736   41.5  101.5  
    63.736   41.5  101.5
```

```
GLAS1 polygon poly_3  
0  
0  
12  
    65.5283  41.5  100.758  
    65.676   41.5  101.5  
    63.736   41.5  101.5  
    63.736   41.5  101.5
```

```
GLAS1 polygon poly_4  
0  
0  
12  
    65.676   41.5  101.5  
    65.5283  41.5  102.242  
    63.736   41.5  101.5
```

재료특성 입력파일

```
### kosmo.mat
#
## this is the material of Kosmo Tower.

# tough ground with brown
void plastic BASE
0
0
5 .102 .071 .005 .07 .9

# light-gray wall
void plastic e1
0
0
5 .90 .90 .90 0.07 0.1

void plastic e3
0
0
5 .90 .90 .90 0.07 0.1

void plastic e5
0
0
5 .90 .90 .90 0.07 0.1

void plastic h1
0
0
5 .90 .90 .90 0.07 0.1

void plastic h2
0
0
5 .90 .90 .90 0.07 0.1

# gray wall
void plastic h3
0
0
```

```

5 .85 .85 .85 0.07 0.1

void plastic TOUGH
0
0
5 .85 .85 .85 0.07 0.1

# this is the material of glass
void glass GLAS1
0
0
3 .56 .56 .96

void glass GLAS2
0
0
3 .56 .56 .96

# ivory wall
void plastic e2
0
0
5 .85 .85 .65 0.07 0.1

void plastic e4
0
0
5 .85 .85 .65 0.07 0.1

void plastic e6
0
0
5 .85 .85 .65 0.07 0.1

void plastic e7
0
0
5 .85 .85 .65 0.07 0.1

void plastic E8
0
0
5 .85 .85 .65 0.07 0.1

```

인공조명을 모델링하기 위한 IES, DAT, RAD 파일

```
IESNA:LM-63-1995
[TEST] BE4426
[DATE] 24-NOV-93
[MANUFAC] BEGA/US
[LUMCAT] 8336
[LUMINAIRE] FLOODLIGHT-NARROW BEAM
[LAMP] (1) 400W T6-G12 CMH
TILT=NONE
  1 14000 14 35 35 2 2 -.3 0 0
  1 1 400
-90 -80 -70 -60 -50 -40 -30 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2
0 2 4 6 8 10 12 14 16 18 20 30 40 50 60 70 80
90
-90 -80 -70 -60 -50 -40 -30 -20 -18 -16 -14 -12 -10 -8 -6 -4 -2
0 2 4 6 8 10 12 14 16 18 20 30 40 50 60 70 80
90
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
0 0 0 0 0 0 0
0 0 0 0 14 84 196 140 126 112 98 84 70 70 56 56 56 56 56 56 56 56 70 70 84 98
112 126 140 196 84 14 0 0 0 0
0 0 0 14 182 70 378 840 868 882 882 896 896 910 910 910 910 910 910 910 910 910 910
910 910 896 896 882 882 868 840 378 70 182 14 0 0 0
0 0 0 84 70 742 924 966 966 966 966 980 980 980 980 980 980 980 980 980 980 980
980 980 980 980 966 966 966 966 924 742 70 84 0 0 0
0 0 0 196 378 924 980 994 994 994 994 994 994 994 994 994 994 994 994 994 994 994
994 994 994 994 994 994 994 994 980 924 378 196 0 0 0
0 0 14 140 840 966 994 994 1022 1050 1120 1204 1288 1386 1456 1512 1540
1554 1540 1512 1456 1386 1288 1204 1120 1050 1022 994 994
966 840 140 14 0 0
0 0 14 126 868 966 994 1022 1050 1148 1260 1372 1498 1596 1694 1764 1806
1820 1806 1764 1694 1596 1498 1372 1260 1148 1050 1022
994 966 868 126 14 0 0
0 0 14 112 882 966 994 1050 1148 1274 1414 1568 1708 1834 1946 2030 2086
2100 2086 2030 1946 1834 1708 1568 1414 1274 1148 1050
994 966 882 112 14 0 0
0 0 14 98 882 966 994 1120 1260 1414 1596 1764 1932 2086 2212 2408 2548
2590 2548 2408 2212 2086 1932 1764 1596 1414 1260 1120
994 966 882 98 14 0 0
0 0 14 84 896 980 994 1204 1372 1568 1764 1974 2170 2464 2800 3066 3402
```

3542 3402 3066 2800 2464 2170 1974 1764 1568 1372 1204
994 980 896 84 14 0 0
0 0 14 70 896 980 994 1288 1498 1708 1932 2170 2562 3024 3836 4578 5040
5208 5040 4578 3836 3024 2562 2170 1932 1708 1498 1288
994 980 896 70 14 0 0
0 0 14 70 910 980 994 1386 1596 1834 2086 2464 3024 4130 5236 8442 10570
11298 10570 8442 5236 4130 3024 2464 2086 1834 1596 1386
994 980 910 70 14 0 0
0 0 14 56 910 980 994 1456 1694 1946 2212 2800 3836 5236 9842 19572
40334 47796 40334 19572 9842 5236 3836 2800 2212 1946 1694
1456 994 980 910 56 14 0 0
0 0 14 56 910 980 994 1512 1764 2030 2408 3066 4578 8442 19572 55958
143206 207144 143206 55958 19572 8442 4578 3066 2408 2030
1764 1512 994 980 910 56 14 0 0
0 0 14 56 910 980 994 1540 1806 2086 2548 3402 5040 10570 40334 143206
366296 432432 366296 143206 40334 10570 5040 3402 2548
2086 1806 1540 994 980 910 56 14 0 0
0 0 14 56 910 980 994 1554 1820 2100 2590 3542 5208 11298 47796 207144
432432 517440 432432 207144 47796 11298 5208 3542 2590
2100 1820 1554 994 980 910 56 14 0 0
0 0 14 56 910 980 994 1540 1806 2086 2548 3402 5040 10570 40334 143206
366296 432432 366296 143206 40334 10570 5040 3402 2548
2086 1806 1540 994 980 910 56 14 0 0
0 0 14 56 910 980 994 1512 1764 2030 2408 3066 4578 8442 19572 55958
143206 207144 143206 55958 19572 8442 4578 3066 2408 2030
1764 1512 994 980 910 56 14 0 0
0 0 14 56 910 980 994 1456 1694 1946 2212 2800 3836 5236 9842 19572
40334 47796 40334 19572 9842 5236 3836 2800 2212 1946 1694
1456 994 980 910 56 14 0 0
0 0 14 70 910 980 994 1386 1596 1834 2086 2464 3024 4130 5236 8442 10570
11298 10570 8442 5236 4130 3024 2464 2086 1834 1596 1386
994 980 910 70 14 0 0
0 0 14 70 896 980 994 1288 1498 1708 1932 2170 2562 3024 3836 4578 5040
5208 5040 4578 3836 3024 2562 2170 1932 1708 1498 1288
994 980 896 70 14 0 0
0 0 14 84 896 980 994 1204 1372 1568 1764 1974 2170 2464 2800 3066 3402
3542 3402 3066 2800 2464 2170 1974 1764 1568 1372 1204
994 980 896 84 14 0 0
0 0 14 98 882 966 994 1120 1260 1414 1596 1764 1932 2086 2212 2408 2548
2590 2548 2408 2212 2086 1932 1764 1596 1414 1260 1120
994 966 882 98 14 0 0
0 0 14 112 882 966 994 1050 1148 1274 1414 1568 1708 1834 1946 2030 2086
2100 2086 2030 1946 1834 1708 1568 1414 1274 1148 1050

994 966 882 112 14 0 0
0 0 14 126 868 966 994 1022 1050 1148 1260 1372 1498 1596 1694 1764 1806
1820 1806 1764 1694 1596 1498 1372 1260 1148 1050 1022
994 966 868 126 14 0 0
0 0 14 140 840 966 994 994 1022 1050 1120 1204 1288 1386 1456 1512 1540
1554 1540 1512 1456 1386 1288 1204 1120 1050 1022 994 994
966 840 140 14 0 0
0 0 0 196 378 924 980 994 994 994 994 994 994 994 994 994 994 994 994 994
994 994 994 994 994 994 994 994 980 924 378 196 0 0 0
0 0 0 84 70 742 924 966 966 966 966 980 980 980 980 980 980 980 980 980
980 980 980 980 966 966 966 966 924 742 70 84 0 0 0
0 0 0 14 182 70 378 840 868 882 882 896 896 910 910 910 910 910 910 910
910 910 896 896 882 882 868 840 378 70 182 14 0 0 0
0 0 0 0 14 84 196 140 126 112 98 84 70 70 56 56 56 56 56 56 56 70 70 84 98
112 126 140 196 84 14 0 0 0 0
0 0 0 0 0 0 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14 14
0 0 0 0 0 0 0
0
0 0

```
# ies2rad -t white
# Dimensions in meters
#<IESNA:LM-63-1995
#<[TEST] BE4426
#<[DATE] 24-NOV-93
#<[MANUFAC] BEGA/US
#<[LUMCAT] 8336
#<[LUMINAIRE] FLOODLIGHT-NARROW BEAM
#<[LAMP] (1) 400W T6-G12 CMH
# 400 watt luminaire, lamp*ballast factor = 1

void brightdata 8336_dist
5 cylcorr 8336.dat source.cal srcB_horiz srcB_vert
0
3 14 0.3 0.0005

8336_dist light white1_light
0
0
3 1 1 1
```