

# Advanced Computer Graphics

## Lecture-08 Introduction to OpenGL-10

**Tzung-Han Lin**

National Taiwan University of Science and Technology  
Graduate Institute of Color and Illumination Technology

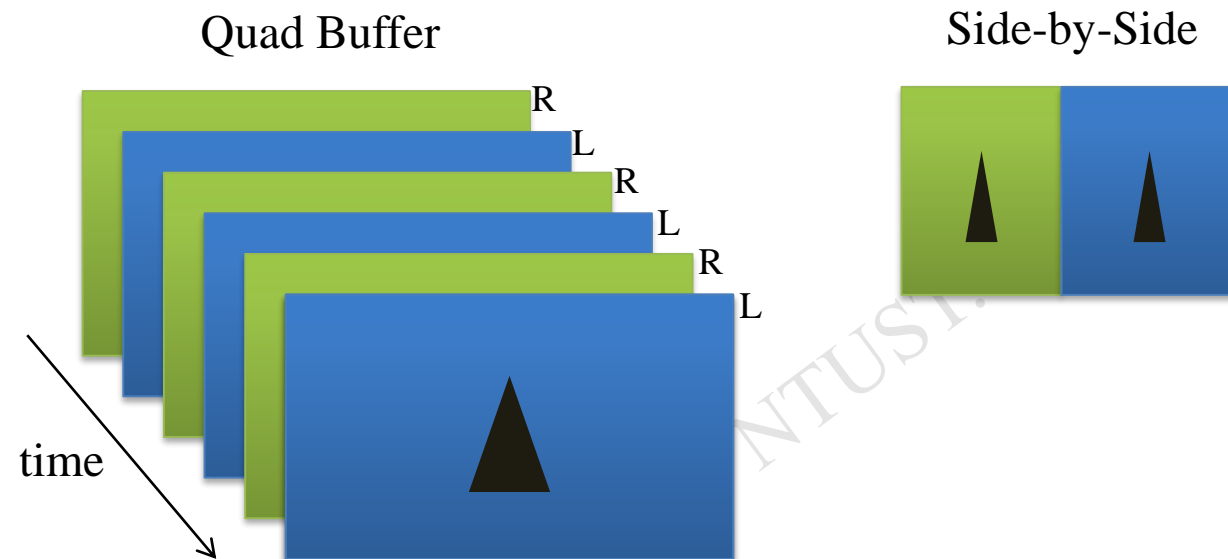
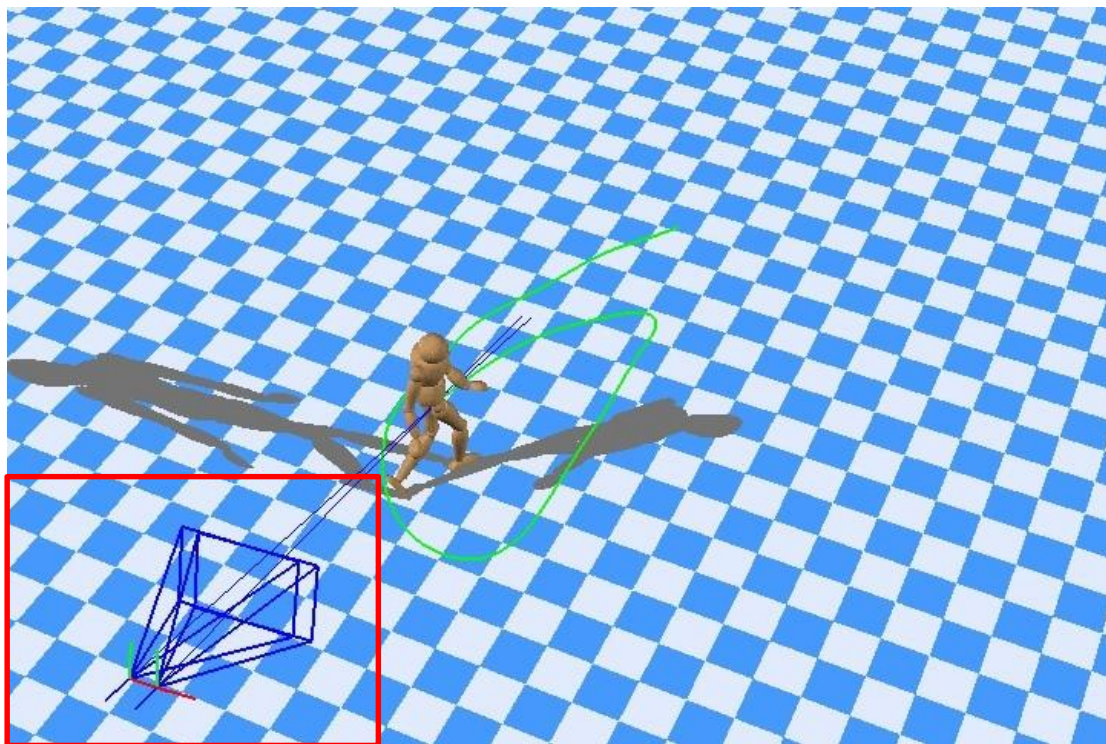
e-mail: [thl@mail.ntust.edu.tw](mailto:thl@mail.ntust.edu.tw)





# Dual cameras:

- Two methods
  - Quad Buffer (sequential)
  - Side-by-Side



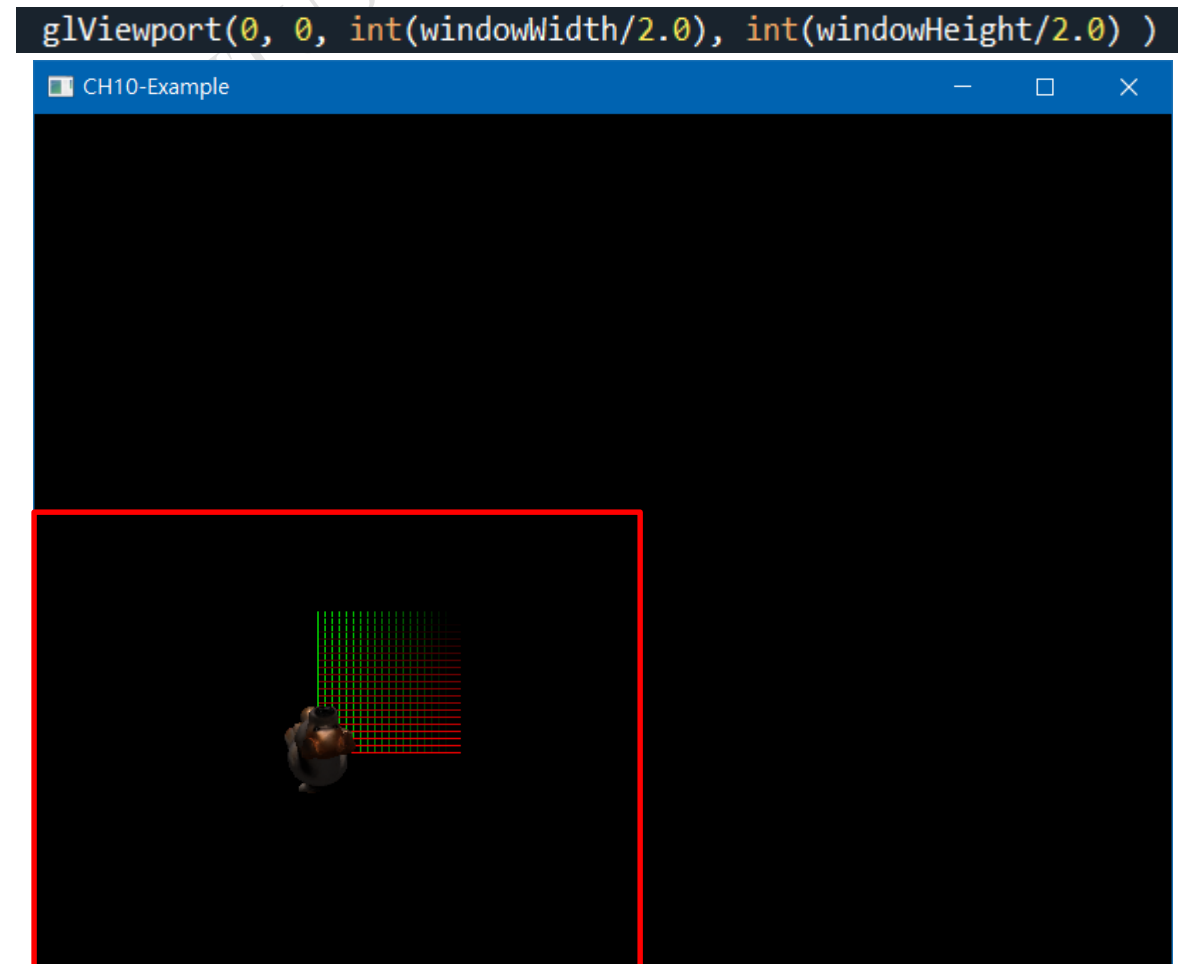
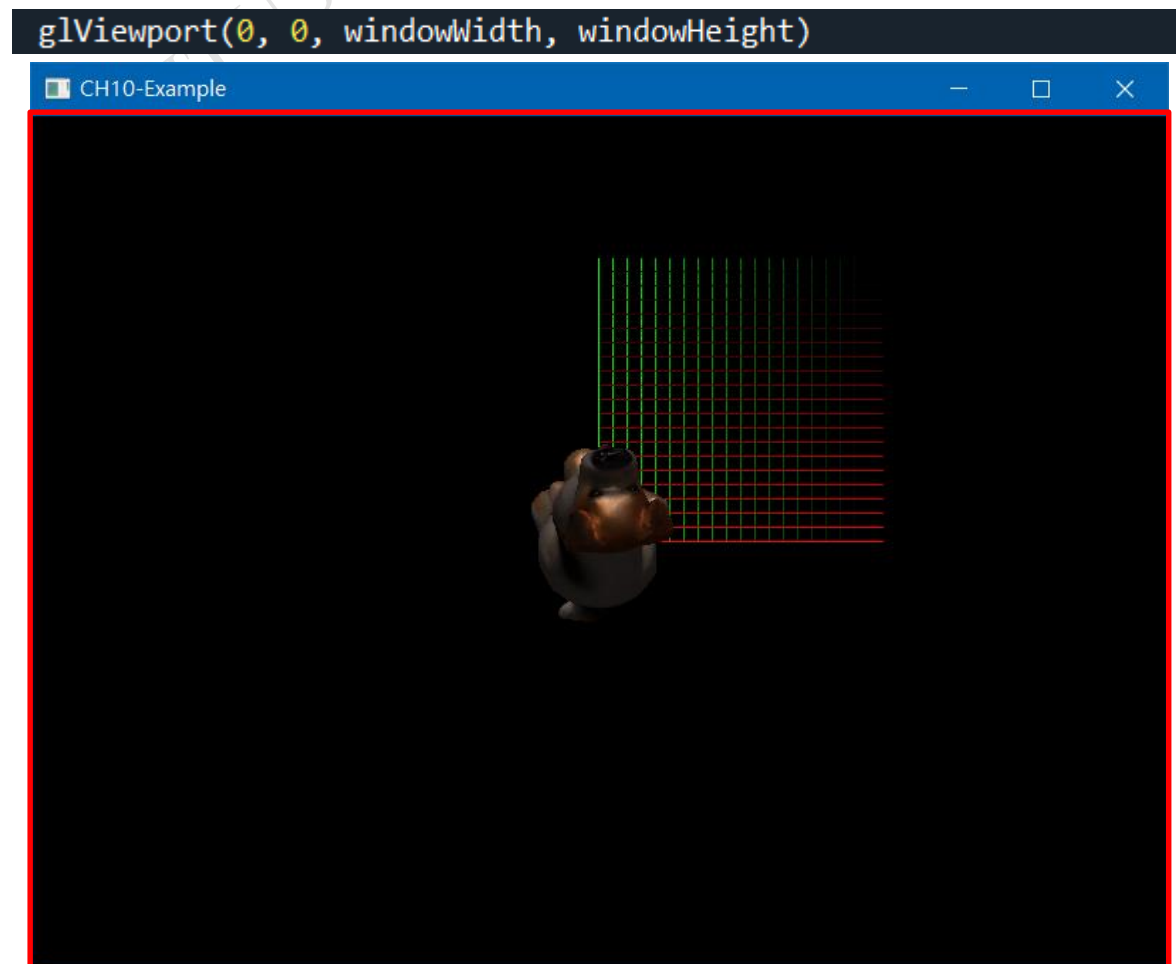


# Side-by-Side image render

- Example for: `glViewport + glOrtho`
- Example for: `glViewport + glFrustum`



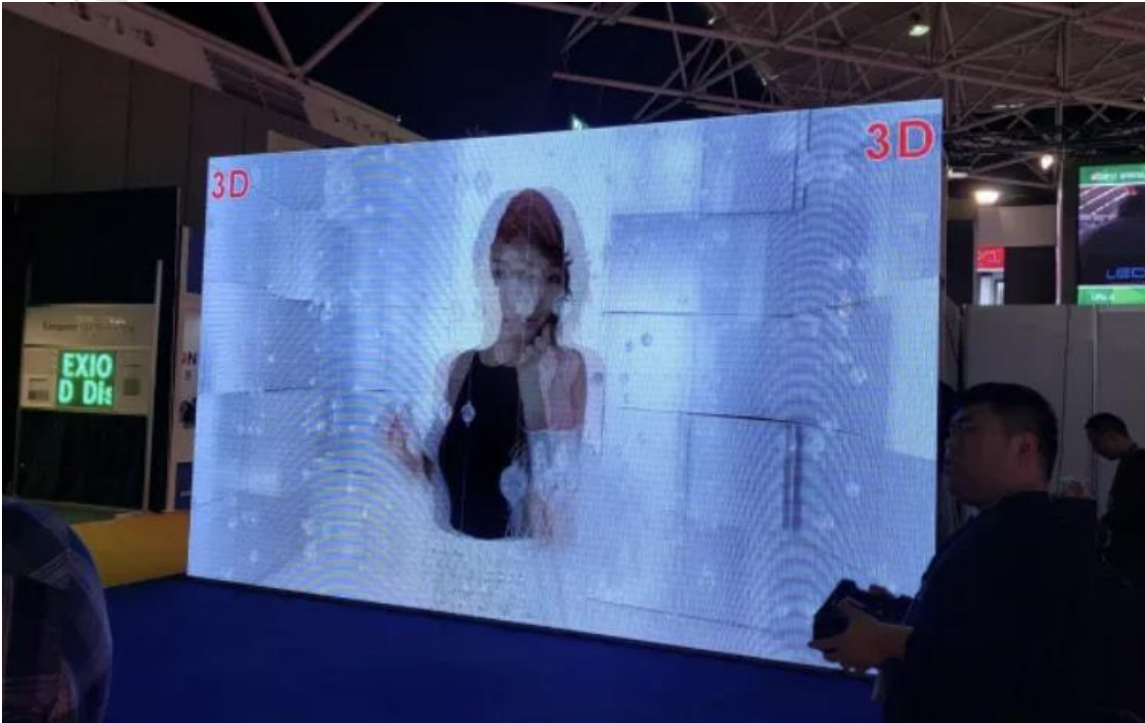
# Example: glViewport





# Note: control the image ratio according your device

3D display (input: 1:2 ratio side-by-side images)  
Display driver will stretch images



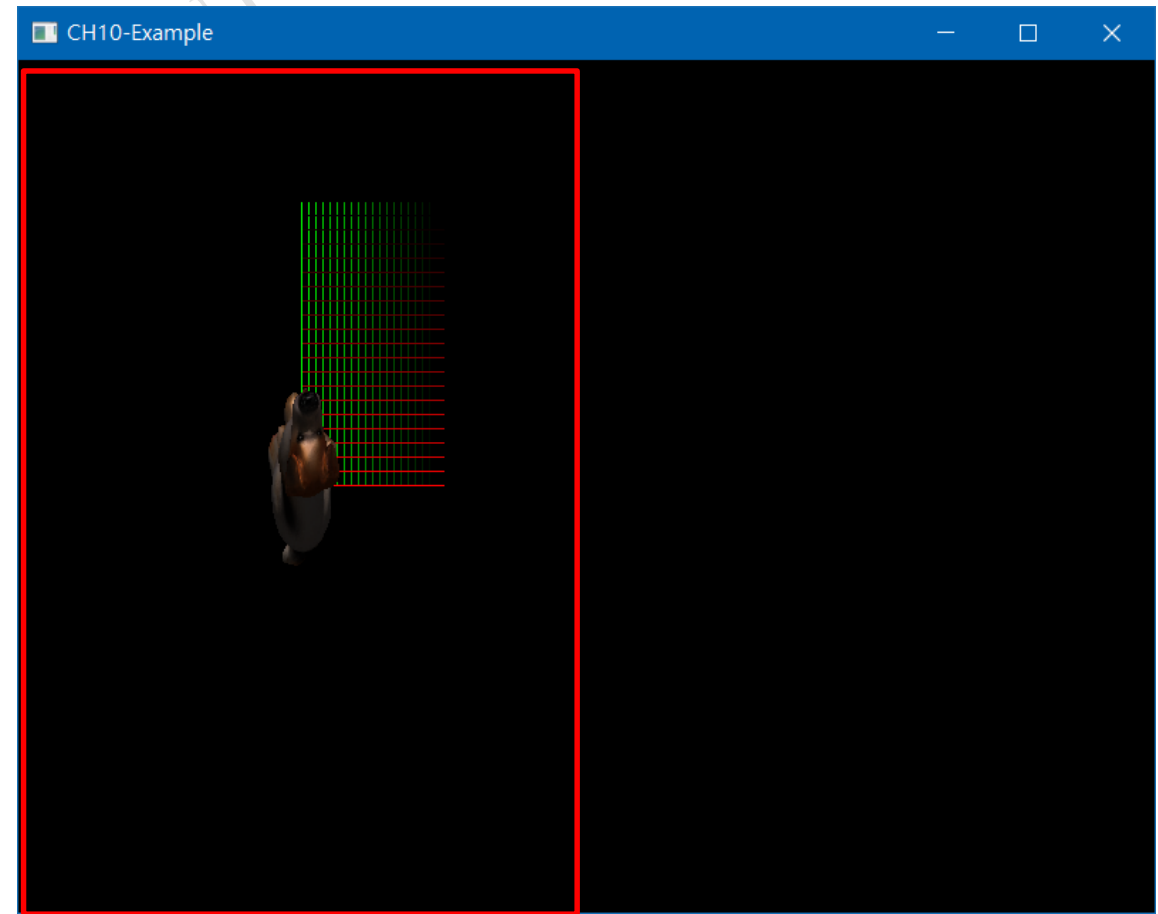
3D gogle (input: 1:1 ratio side-by-side images)





# 1:2 Ratio glortho-half

```
def display():
    glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
    glMatrixMode(GL_PROJECTION)
    glLoadIdentity()
    glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
    glViewport(0, 0, int(windowWidth/2.0), windowHeight)
    glOrtho(-float(windowWidth)/2.0, float(windowWidth)/2.0, -float(windowHeight)/2.0, float(windowHeight)/2.0, -
    windowHeight*10.0, windowHeight*10.0)
    gluLookAt(0,0,1000,0,0,0,0,1,0)
    glEnable(GL_LIGHTING)
    glMatrixMode(GL_MODELVIEW)
    glPushMatrix()
    global transfMatrix
    transfMatrixT = np.transpose(transfMatrix)
    matmatlist = [transfMatrixT[i][j] for i in range(4) for j in range(4)]
    glLoadMatrixf(matmatlist)
    visualization.draw(meshes)
    glPopMatrix()
    glDisable(GL_LIGHTING)
    drawGrid()
    glutSwapBuffers()
```







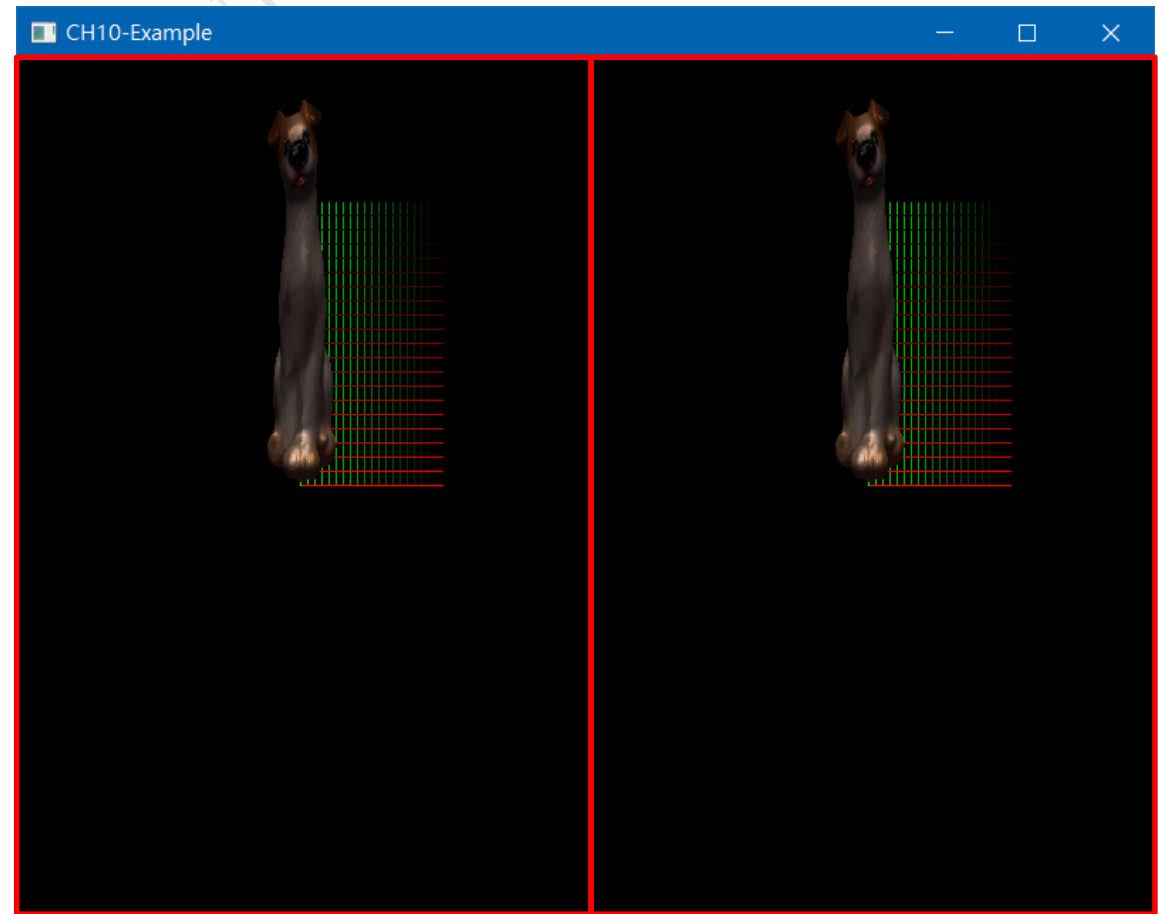
# 1:2 Ratio glortho-side by side (no disparity)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glOrtho(-float(windowWidth)/2.0, float(windowWidth)/2.0, -
50             float(windowHeight)/2.0, float(windowHeight)/2.0, -
51             windowHeight*10.0, windowHeight*10.0)
52     gluLookAt(0,0,1000,0,0,0,0,1,0)
53     glEnable(GL_LIGHTING)
54     glMatrixMode(GL_MODELVIEW)
55     glPushMatrix()
56     global transfMatrix
57     transfMatrixT = np.transpose(transfMatrix)
58     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
59                   range(4)]
60     glLoadMatrixf(matmatList)
61     visualization.draw(meshes)
62     glPopMatrix()
63     glDisable(GL_LIGHTING)
64     drawGrid()
65
66     glMatrixMode(GL_PROJECTION)
67     glLoadIdentity()
68     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
69     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
70               windowHeight)
71     glOrtho(-float(windowWidth)/2.0, float(windowWidth)/2.0, -
72             float(windowHeight)/2.0, float(windowHeight)/2.0, -
73             windowHeight*10.0, windowHeight*10.0)
74     gluLookAt(0,0,1000,0,0,0,0,1,0)
75     glEnable(GL_LIGHTING)
76     glMatrixMode(GL_MODELVIEW)
77     glPushMatrix()
78
79     transfMatrixT = np.transpose(transfMatrix)
80     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
81                   range(4)]
82     glLoadMatrixf(matmatList)
83     visualization.draw(meshes)
84     glPopMatrix()
85     glDisable(GL_LIGHTING)
86     drawGrid()
87
88     glutSwapBuffers()

```

Note ratio (image is compressed)





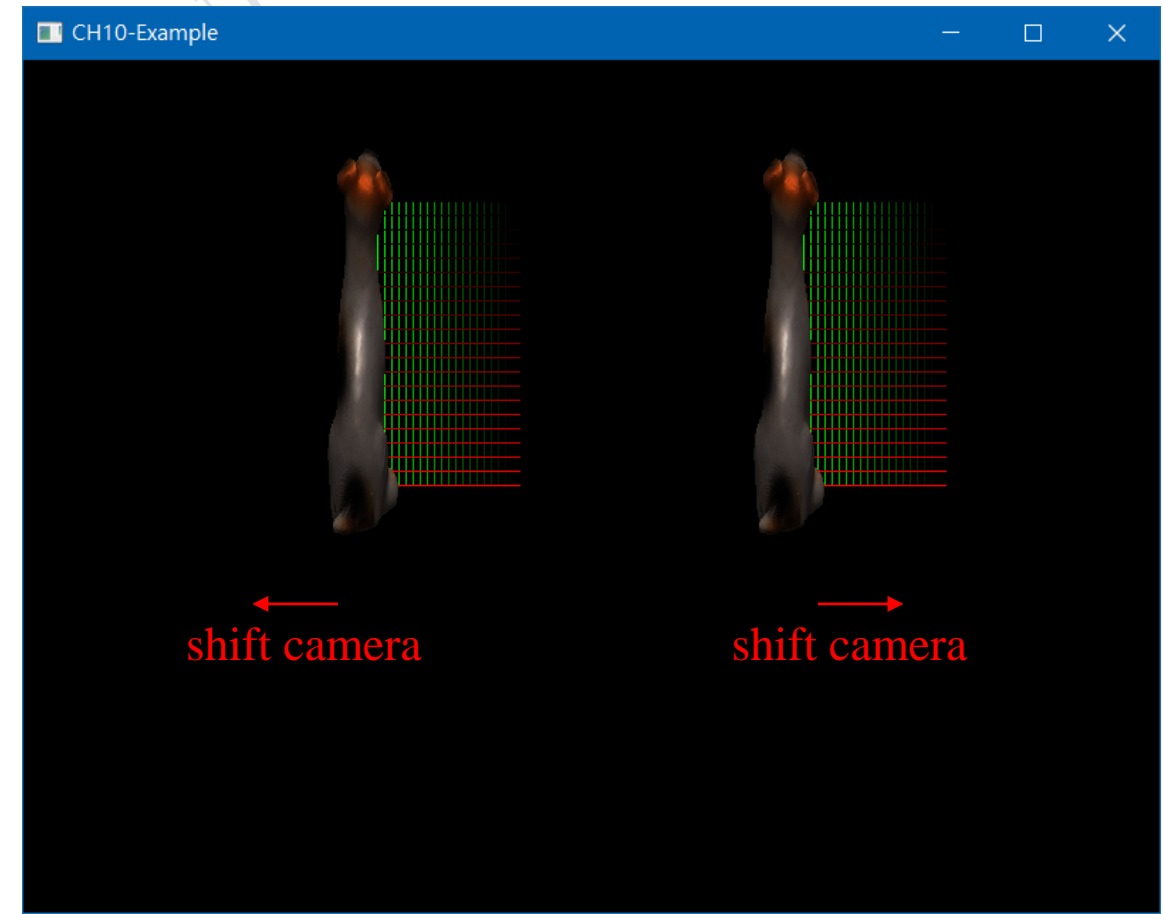
# 1:2 Ratio glortho-side by side (with disparity)

## ■ Shift camera's positions (parallel configuration)

```

42
43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glOrtho(-float(windowWidth)/2.0,float(windowWidth)/2.0,-
float(windowHeight)/2.0,float(windowHeight)/2.0,-
windowHeight*10.0,windowHeight*10.0)
50     gluLookAt(-100,0,1000,-100,0,0,0,1,0)
51     glEnable(GL_LIGHTING)
52     glMatrixMode(GL_MODELVIEW)
53     glPushMatrix()
54     global transfMatrix
55     transfMatrixT = np.transpose(transfMatrix)
56     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
57     glLoadMatrixf(matmatList)
58     visualization.draw(meshes)
59     glPopMatrix()
60     glDisable(GL_LIGHTING)
61     drawGrid()
62
63     glMatrixMode(GL_PROJECTION)
64     glLoadIdentity()
65     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
66     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
windowHeight)
67     glOrtho(-float(windowWidth)/2.0,float(windowWidth)/2.0,-
float(windowHeight)/2.0,float(windowHeight)/2.0,-
windowHeight*10.0,windowHeight*10.0)
68     gluLookAt(100,0,1000,100,0,0,0,1,0)
69     glEnable(GL_LIGHTING)
70     glMatrixMode(GL_MODELVIEW)
71     glPushMatrix()
72
73     transfMatrixT = np.transpose(transfMatrix)
74     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
75     glLoadMatrixf(matmatList)
76     visualization.draw(meshes)
77     glPopMatrix()
78     glDisable(GL_LIGHTING)
79     drawGrid()
80
81     glutSwapBuffers()
82
83

```







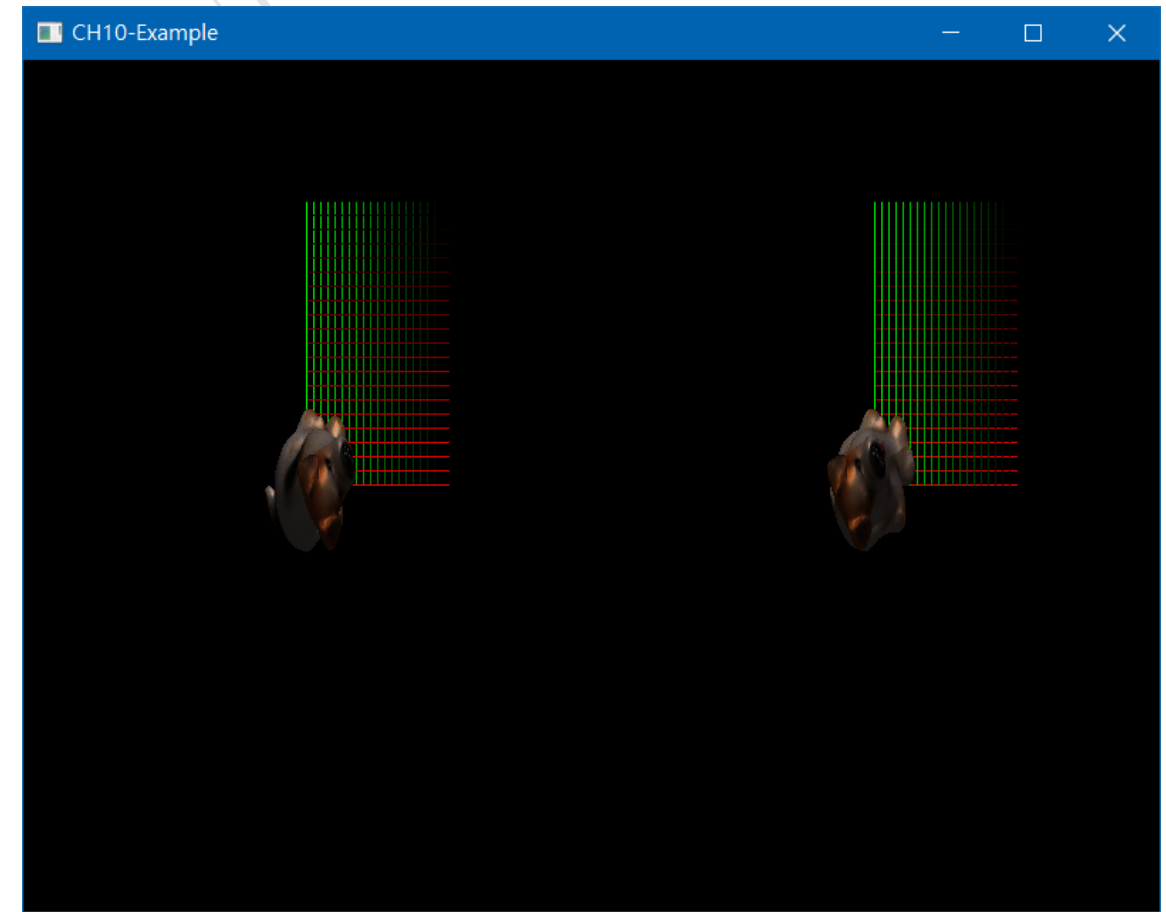
# 1:2 Ratio glortho-side by side (with disparity)

- Shift camera's positions (converged configuration)

```

42
43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glOrtho(-float(windowWidth)/2.0,float(windowWidth)/2.0,-
float(windowHeight)/2.0,float(windowHeight)/2.0,-
windowHeight*10.0,windowHeight*10.0)
50     gluLookAt(-100,0,1000,0,0,0,0,1,0)
51     glEnable(GL_LIGHTING)
52     glMatrixMode(GL_MODELVIEW)
53     glPushMatrix()
54     global transfMatrix
55     transfMatrixT = np.transpose(transfMatrix)
56     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
57     glLoadMatrixf(matmatList)
58     visualization.draw(meshes)
59     glPopMatrix()
60     glDisable(GL_LIGHTING)
61     drawGrid()
62
63
64     glMatrixMode(GL_PROJECTION)
65     glLoadIdentity()
66     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
67     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
windowHeight)
68     glOrtho(-float(windowWidth)/2.0,float(windowWidth)/2.0,-
float(windowHeight)/2.0,float(windowHeight)/2.0,-
windowHeight*10.0,windowHeight*10.0)
69     gluLookAt(100,0,1000,0,0,0,0,1,0)
70     glEnable(GL_LIGHTING)
71     glMatrixMode(GL_MODELVIEW)
72     glPushMatrix()
73
74     transfMatrixT = np.transpose(transfMatrix)
75     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
76     glLoadMatrixf(matmatList)
77     visualization.draw(meshes)
78     glPopMatrix()
79     glDisable(GL_LIGHTING)
80     drawGrid()
81
82     glutSwapBuffers()

```





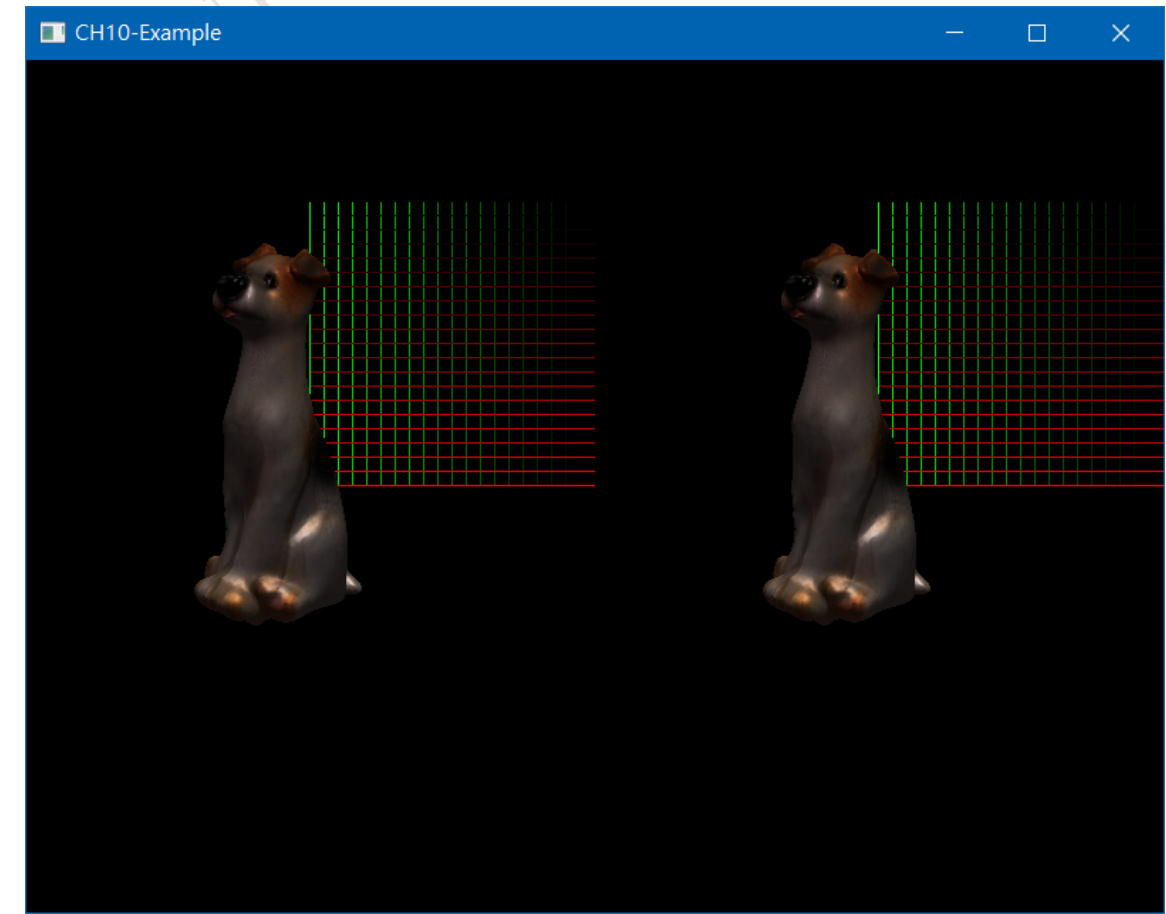
# 1:1 Ratio glortho-side by side (no disparity)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glOrtho(-float(windowWidth)/4.0,float(windowWidth)/4.0,-
50             float(windowHeight)/2.0,float(windowHeight)/2.0,-
51             windowHeight*10.0,windowHeight*10.0)
52     gluLookAt(0,0,1000,0,0,0,1,0)
53     glEnable(GL_LIGHTING)
54     glMatrixMode(GL_MODELVIEW)
55     glPushMatrix()
56     global transfMatrix
57     transfMatrixT = np.transpose(transfMatrix)
58     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
59                   range(4)]
60     glLoadMatrixf(matmatList)
61     visualization.draw(meshes)
62     glPopMatrix()
63     glDisable(GL_LIGHTING)
64     drawGrid()
65
66     glMatrixMode(GL_PROJECTION)
67     glLoadIdentity()
68     glOrtho(-float(windowWidth)/4.0,float(windowWidth)/4.0,-
69             float(windowHeight)/2.0,float(windowHeight)/2.0,-
70             windowHeight*10.0,windowHeight*10.0)
71     gluLookAt(0,0,1000,0,0,0,1,0)
72     glEnable(GL_LIGHTING)
73     glMatrixMode(GL_MODELVIEW)
74     glPushMatrix()
75     global transfMatrix
76     transfMatrixT = np.transpose(transfMatrix)
77     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
78                   range(4)]
79     glLoadMatrixf(matmatList)
80     visualization.draw(meshes)
81     glPopMatrix()
82     glDisable(GL_LIGHTING)
83     drawGrid()
84
85     glutSwapBuffers()

```

Note ratio





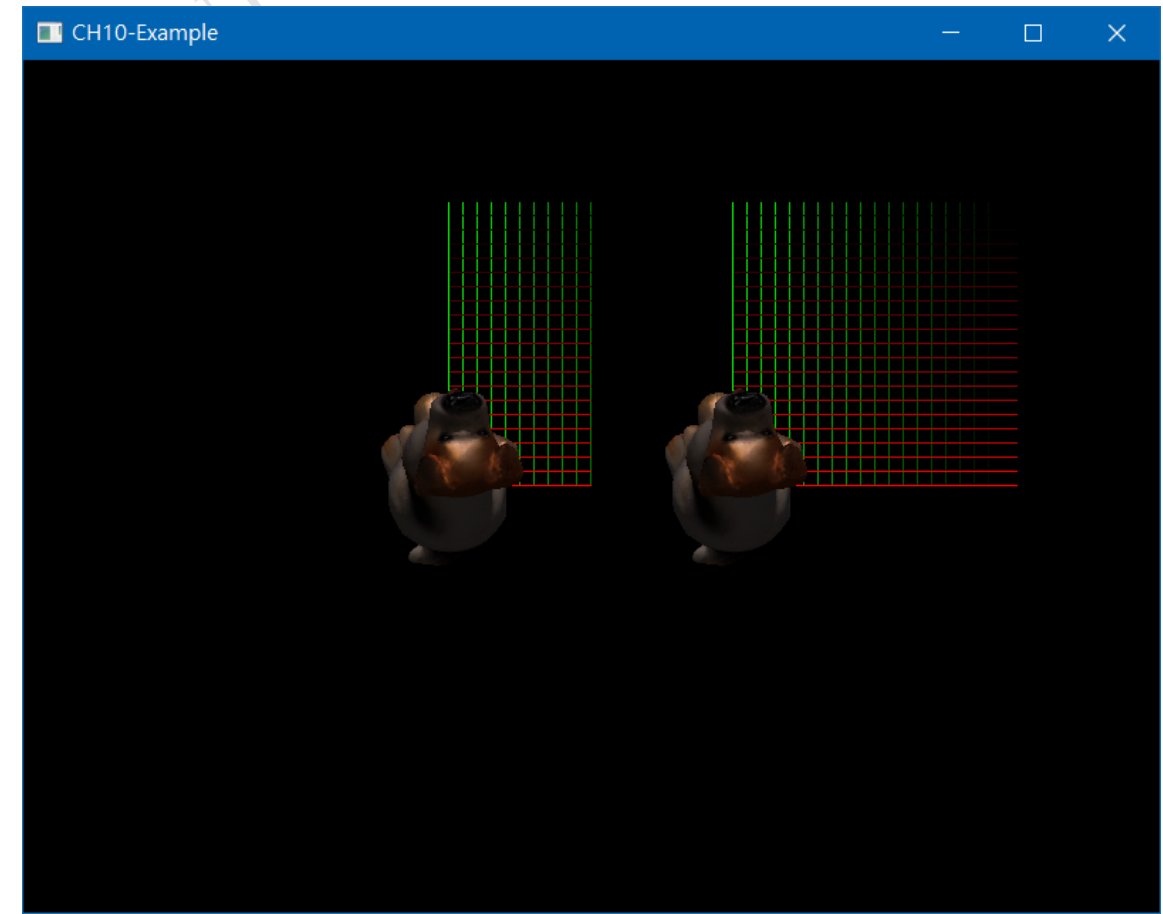
# 1:1 Ratio glortho-side by side (with disparity)

## ■ Shift camera's positions (parallel configuration)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glOrtho(-float(windowWidth)/4.0,float(windowWidth)/4.0,-
float(windowHeight)/2.0,float(windowHeight)/2.0,-
windowHeight*10.0,windowHeight*10.0)
50     gluLookAt(-100,0,1000,-100,0,0,0,1,0)
51     glEnable(GL_LIGHTING)
52     glMatrixMode(GL_MODELVIEW)
53     glPushMatrix()
54     global transfMatrix
55     transfMatrixT = np.transpose(transfMatrix)
56     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
57     glLoadMatrixf(matmatList)
58     visualization.draw(meshes)
59     glPopMatrix()
60     glDisable(GL_LIGHTING)
61     drawGrid()
62
63     glMatrixMode(GL_PROJECTION)
64     glLoadIdentity()
65     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
66     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
windowHeight)
67     glOrtho(-float(windowWidth)/4.0,float(windowWidth)/4.0,-
float(windowHeight)/2.0,float(windowHeight)/2.0,-
windowHeight*10.0,windowHeight*10.0)
68     gluLookAt(100,0,1000,100,0,0,0,1,0)
69     glEnable(GL_LIGHTING)
70     glMatrixMode(GL_MODELVIEW)
71     glPushMatrix()
72
73     transfMatrixT = np.transpose(transfMatrix)
74     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
75     glLoadMatrixf(matmatList)
76     visualization.draw(meshes)
77     glPopMatrix()
78     glDisable(GL_LIGHTING)
79     drawGrid()
80
81     glutSwapBuffers()
82
83

```





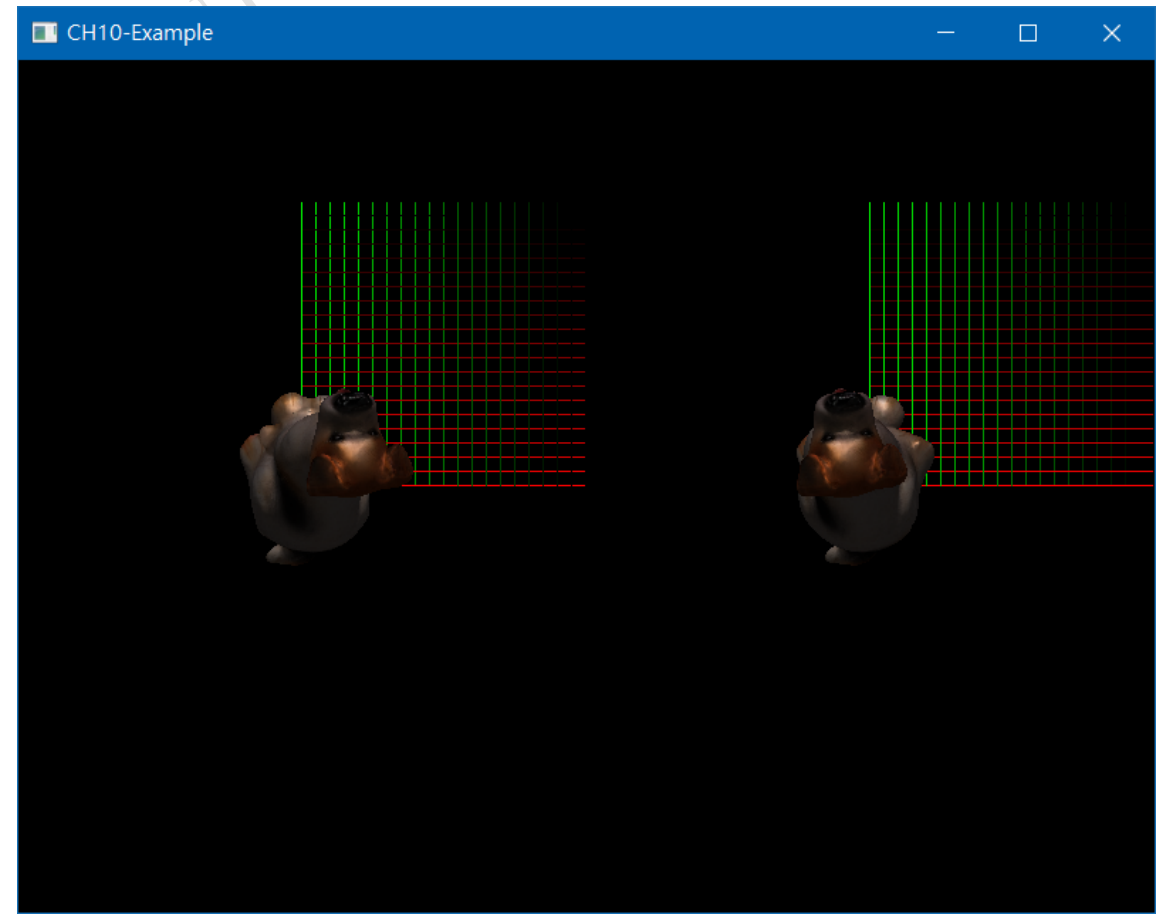
# 1:1 Ratio glortho-side by side (with disparity)

## ■ Shift camera's positions (converged configuration)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glOrtho(-float(windowWidth)/4.0,float(windowWidth)/4.0,-
float(windowHeight)/2.0,float(windowHeight)/2.0,-
windowHeight*10.0,windowHeight*10.0)
50     gluLookAt(-100,0,1000,0,0,0,0,0,1,0)
51     glEnable(GL_LIGHTING)
52     glMatrixMode(GL_MODELVIEW)
53     glPushMatrix()
54     global transfMatrix
55     transfMatrixT = np.transpose(transfMatrix)
56     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
57     glLoadMatrixf(matmatList)
58     visualization.draw(meshes)
59     glPopMatrix()
60     glDisable(GL_LIGHTING)
61     drawGrid()
62
63
64     glMatrixMode(GL_PROJECTION)
65     glLoadIdentity()
66     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
67     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
windowHeight)
68     glOrtho(-float(windowWidth)/4.0,float(windowWidth)/4.0,-
float(windowHeight)/2.0,float(windowHeight)/2.0,-
windowHeight*10.0,windowHeight*10.0)
69     gluLookAt(100,0,1000,0,0,0,0,0,1,0)
70     glEnable(GL_LIGHTING)
71     glMatrixMode(GL_MODELVIEW)
72     glPushMatrix()
73
74     transfMatrixT = np.transpose(transfMatrix)
75     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
76     glLoadMatrixf(matmatList)
77     visualization.draw(meshes)
78     glPopMatrix()
79     glDisable(GL_LIGHTING)
80     drawGrid()
81
82     glutSwapBuffers()
83

```



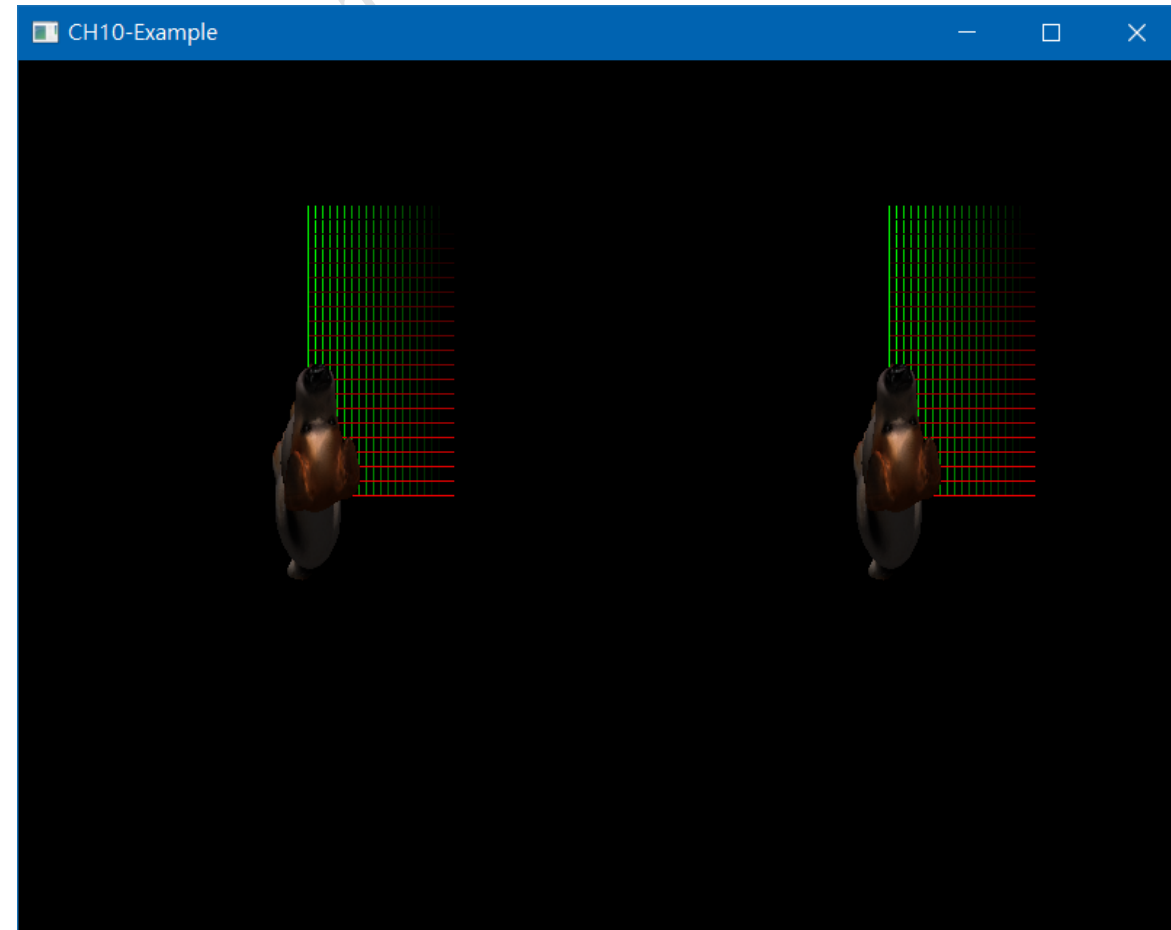


# 1:2 Ratio glFrustum-side by side (no disparity)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glFrustum(-800/2000.0, 800/2000.0, - 600/2000.0, 600/2000.0,
50             1.0, 5000)
51     gluLookAt(0,0,1000,0,0,0,1,0)
52     glEnable(GL_LIGHTING)
53     glMatrixMode(GL_MODELVIEW)
54     glPushMatrix()
55     global transfMatrix
56     transfMatrixT = np.transpose(transfMatrix)
57     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
58                 range(4)]
59     glLoadMatrixf(matmatList)
60     visualization.draw(meshes)
61     glPopMatrix()
62     glDisable(GL_LIGHTING)
63     drawGrid()
64
65     glMatrixMode(GL_PROJECTION)
66     glLoadIdentity()
67     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
68     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
69             windowHeight)
70     glFrustum(-800/2000.0, 800/2000.0, - 600/2000.0, 600/2000.0,
71             1.0, 5000)
72     gluLookAt(0,0,1000,0,0,0,1,0)
73     glEnable(GL_LIGHTING)
74     glMatrixMode(GL_MODELVIEW)
75     glPushMatrix()
76
77     transfMatrixT = np.transpose(transfMatrix)
78     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
79                 range(4)]
80     glLoadMatrixf(matmatList)
81     visualization.draw(meshes)
82     glPopMatrix()
83     glDisable(GL_LIGHTING)
84     drawGrid()
85
86     glutSwapBuffers()

```





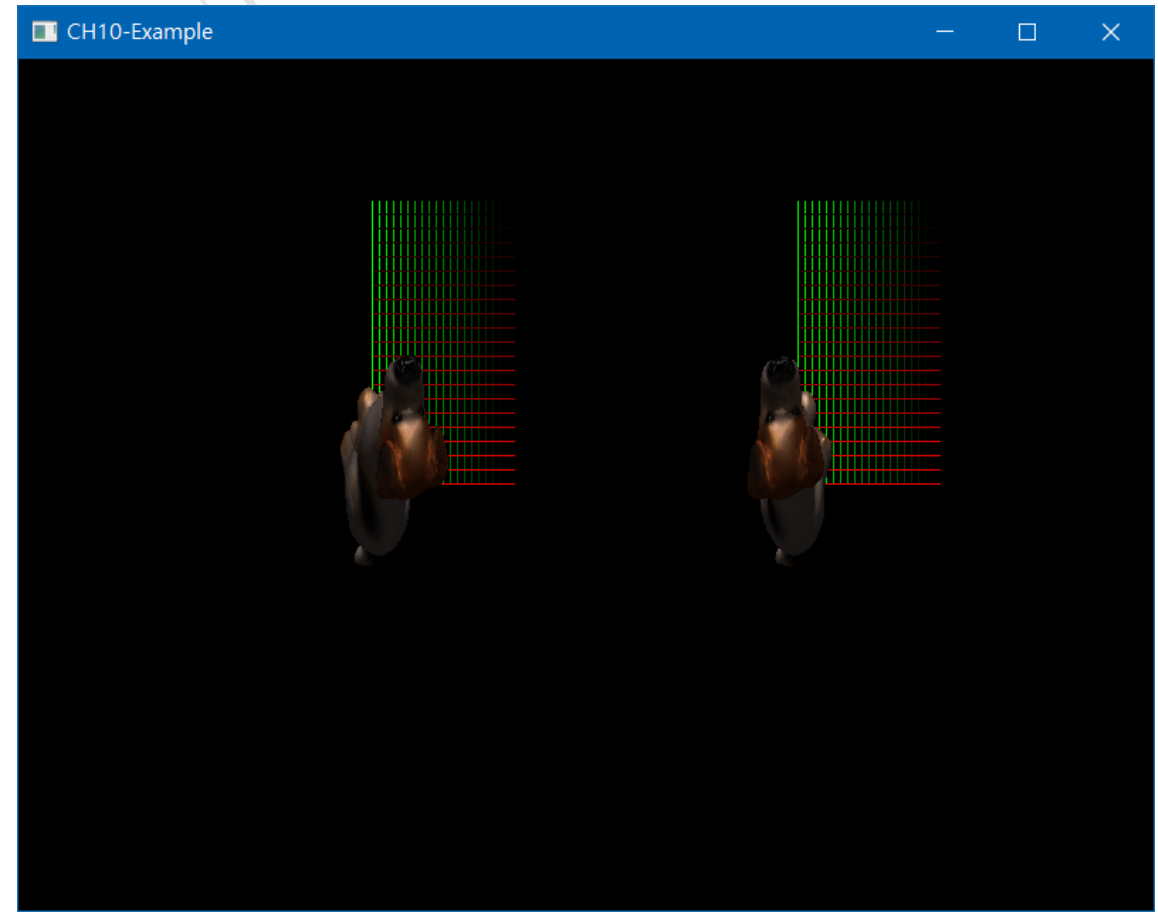
# 1:2 Ratio glfrustum-side by side (with disparity)

## ■ Shift camera's positions (parallel configuration)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glFrustum(-800/2000.0, 800/2000.0, - 600/2000.0, 600/2000.0,
50     1.0, 5000)
51     gluLookAt(-100,0,1000,-100,0,0,0,1,0)
52     glEnable(GL_LIGHTING)
53     glMatrixMode(GL_MODELVIEW)
54     glPushMatrix()
55     global transfMatrix
56     transfMatrixT = np.transpose(transfMatrix)
57     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
58     range(4)]
59     glLoadMatrixf(matmatList)
60     visualization.draw(meshes)
61     glPopMatrix()
62     glDisable(GL_LIGHTING)
63     drawGrid()
64
65     glMatrixMode(GL_PROJECTION)
66     glLoadIdentity()
67     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
68     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
69     windowHeight)
70     glFrustum(-800/2000.0, 800/2000.0, - 600/2000.0, 600/2000.0,
71     1.0, 5000)
72     gluLookAt(100,0,1000,100,0,0,0,1,0)
73     glEnable(GL_LIGHTING)
74     glMatrixMode(GL_MODELVIEW)
75     glPushMatrix()
76     global transfMatrix
77     transfMatrixT = np.transpose(transfMatrix)
78     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
79     range(4)]
80     glLoadMatrixf(matmatList)
81     visualization.draw(meshes)
82     glPopMatrix()
83     glDisable(GL_LIGHTING)
84     drawGrid()
85     glutSwapBuffers()
86

```





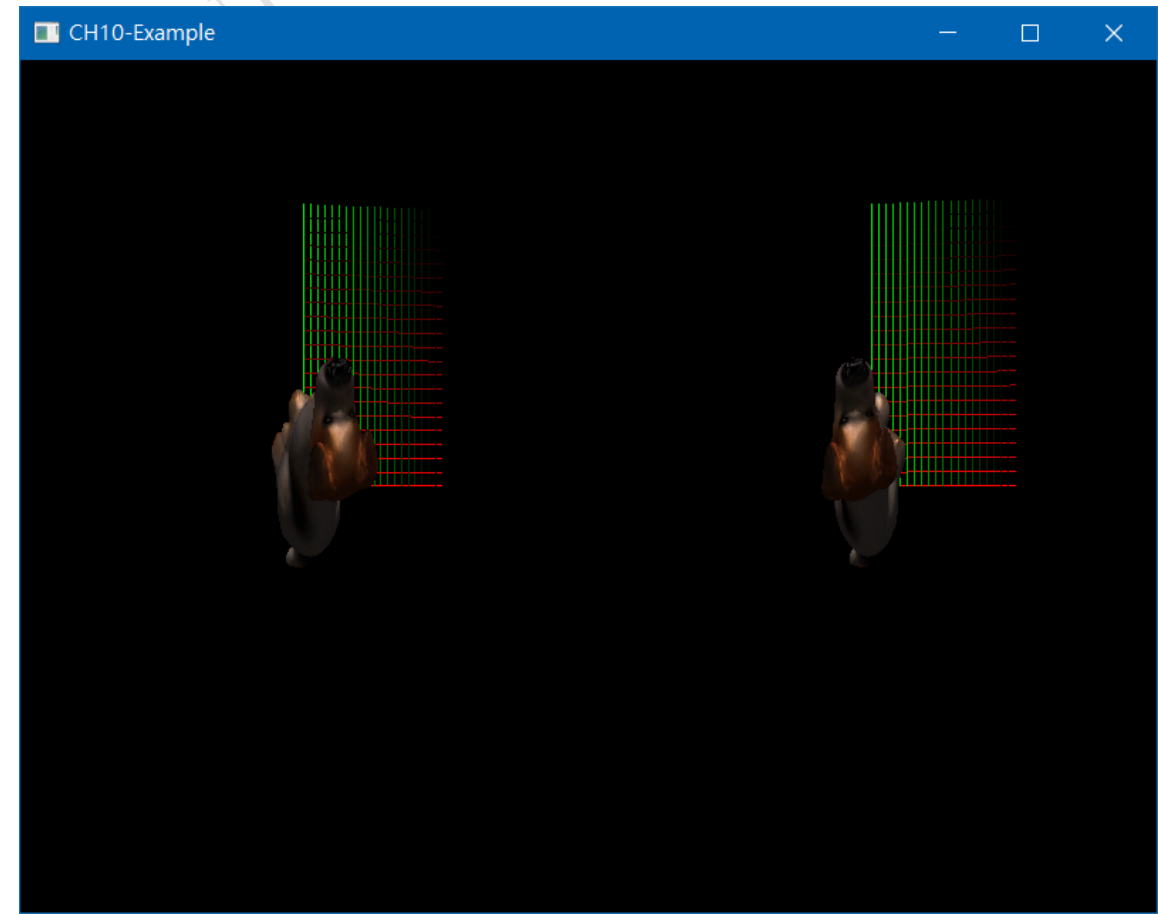
# 1:2 Ratio glfrustum-side by side (with disparity)

## ■ Shift camera's positions (converged configuration)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glFrustum(-800/2000.0, 800/2000.0, - 600/2000.0, 600/2000.0,
50             1.0, 5000)
51     gluLookAt(-100,0,1000,0,0,0,0,1,0)
52     glEnable(GL_LIGHTING)
53     glMatrixMode(GL_MODELVIEW)
54     glPushMatrix()
55     global transfMatrix
56     transfMatrixT = np.transpose(transfMatrix)
57     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
58                 range(4)]
59     glLoadMatrixf(matmatList)
60     visualization.draw(meshes)
61     glPopMatrix()
62     glDisable(GL_LIGHTING)
63     drawGrid()
64
65     glMatrixMode(GL_PROJECTION)
66     glLoadIdentity()
67     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
68     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
69             windowHeight)
70     glFrustum(-800/2000.0, 800/2000.0, - 600/2000.0, 600/2000.0,
71             1.0, 5000)
72     gluLookAt(100,0,1000,0,0,0,0,1,0)
73     glEnable(GL_LIGHTING)
74     glMatrixMode(GL_MODELVIEW)
75     glPushMatrix()
76     global transfMatrix
77     transfMatrixT = np.transpose(transfMatrix)
78     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
79                 range(4)]
80     glLoadMatrixf(matmatList)
81     visualization.draw(meshes)
82     glPopMatrix()
83     glDisable(GL_LIGHTING)
84     drawGrid()
85
86     glutSwapBuffers()
87

```





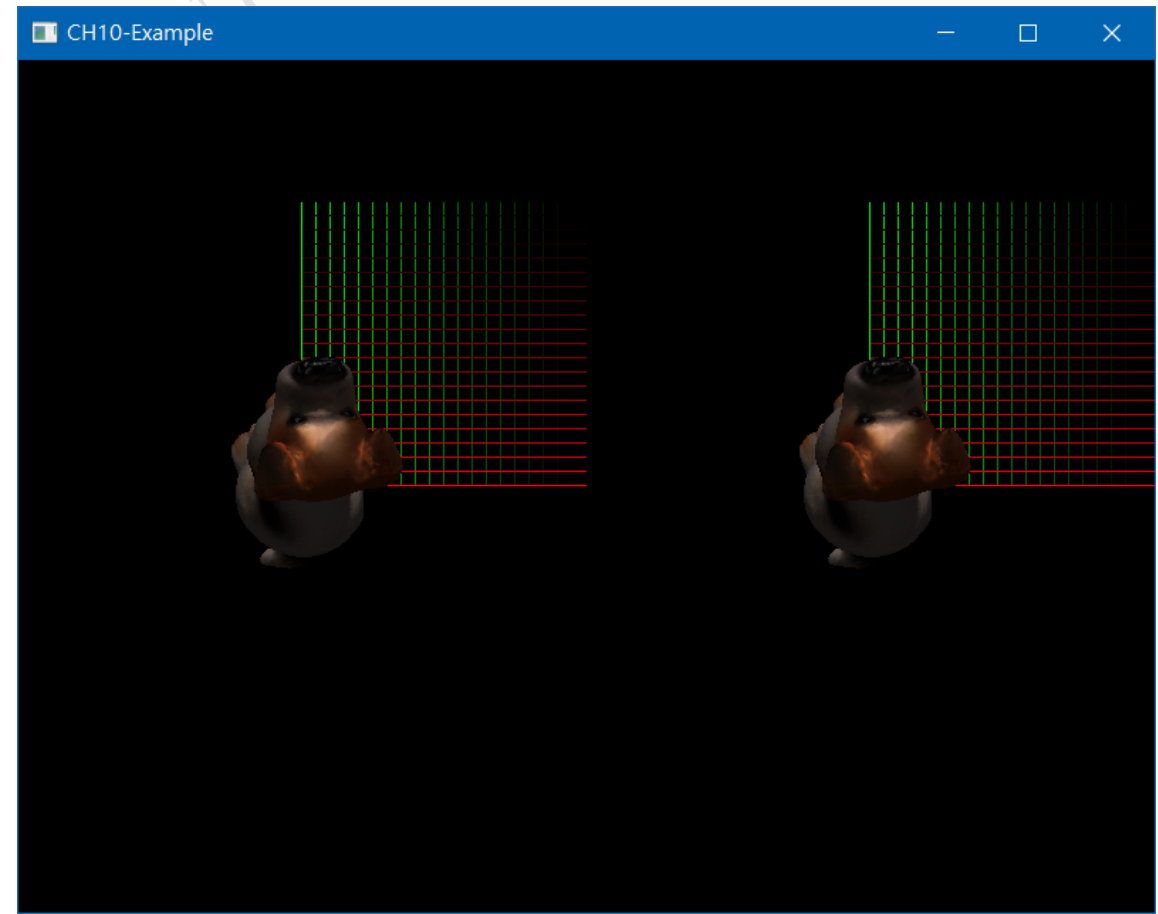


# 1:1 Ratio glFrustum-side by side (no disparity)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glFrustum(-400/2000.0, 400/2000.0, - 600/2000.0, 600/2000.0,
50             1.0, 5000)
51     gluLookAt(0,0,1000,0,0,0,1,0)
52     glEnable(GL_LIGHTING)
53     glMatrixMode(GL_MODELVIEW)
54     glPushMatrix()
55     global transfMatrix
56     transfMatrixT = np.transpose(transfMatrix)
57     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
58                 range(4)]
59     glLoadMatrixf(matmatList)
60     visualization.draw(meshes)
61     glPopMatrix()
62     glDisable(GL_LIGHTING)
63     drawGrid()
64
65     glMatrixMode(GL_PROJECTION)
66     glLoadIdentity()
67     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
68     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
69             windowHeight)
70     glFrustum(-400/2000.0, 400/2000.0, - 600/2000.0, 600/2000.0,
71             1.0, 5000)
72     gluLookAt(0,0,1000,0,0,0,1,0)
73     glEnable(GL_LIGHTING)
74     glMatrixMode(GL_MODELVIEW)
75     glPushMatrix()
76
77     transfMatrixT = np.transpose(transfMatrix)
78     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
79                 range(4)]
80     glLoadMatrixf(matmatList)
81     visualization.draw(meshes)
82     glPopMatrix()
83     glDisable(GL_LIGHTING)
84     drawGrid()
85
86     glutSwapBuffers()

```





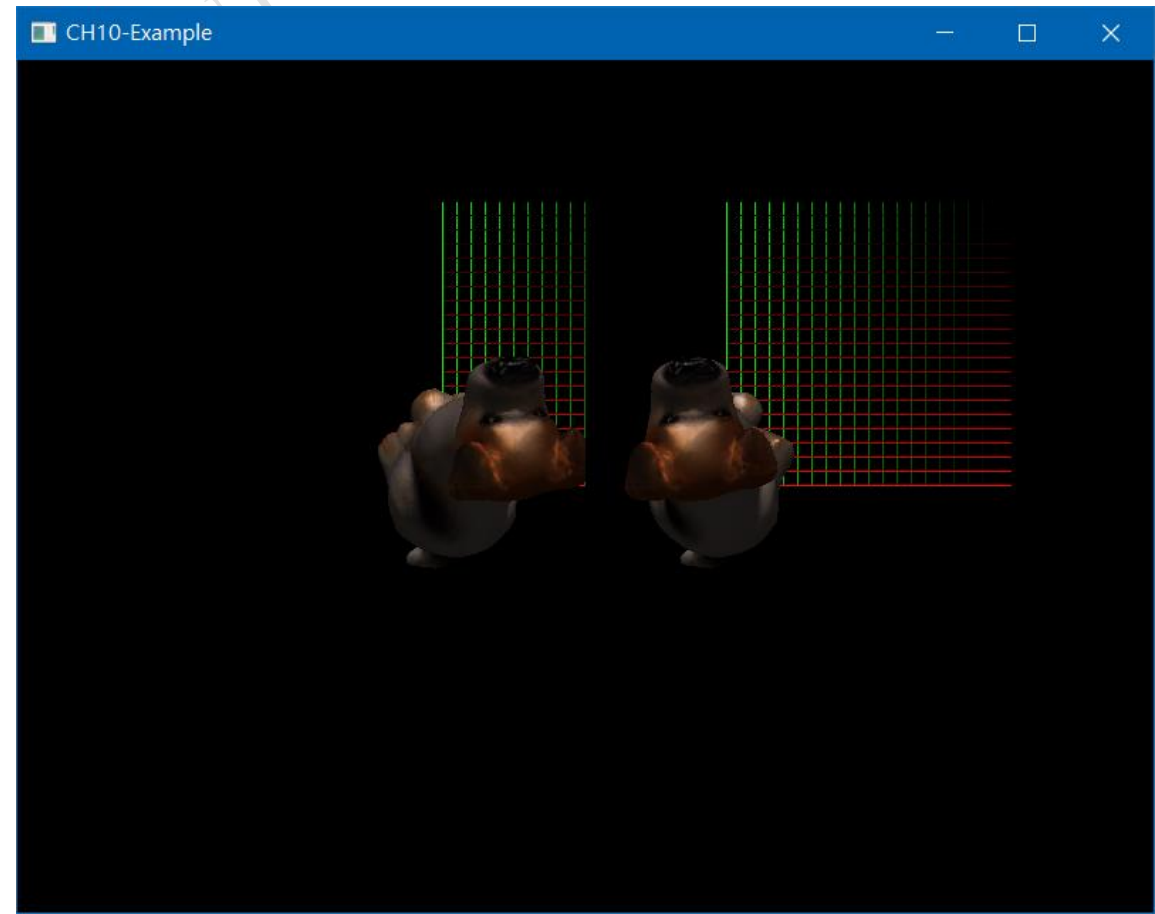
# 1:1 Ratio glfrustum-side by side (with disparity)

- Shift camera's positions (parallel configuration)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glFrustum(-400/2000.0, 400/2000.0, - 600/2000.0, 600/2000.0,
50             1.0, 5000)
51     gluLookAt(-100,0,1000,-100,0,0,0,1,0)
52     glEnable(GL_LIGHTING)
53     glMatrixMode(GL_MODELVIEW)
54     glPushMatrix()
55     global transfMatrix
56     transfMatrixT = np.transpose(transfMatrix)
57     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
58                 range(4)]
59     glLoadMatrixf(matmatList)
60     visualization.draw(meshes)
61     glPopMatrix()
62     glDisable(GL_LIGHTING)
63     drawGrid()
64
65     glMatrixMode(GL_PROJECTION)
66     glLoadIdentity()
67     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
68     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
69             windowHeight)
70     glFrustum(-400/2000.0, 400/2000.0, - 600/2000.0, 600/2000.0,
71             1.0, 5000)
72     gluLookAt(100,0,1000,100,0,0,0,1,0)
73     glEnable(GL_LIGHTING)
74     glMatrixMode(GL_MODELVIEW)
75     glPushMatrix()
76     global transfMatrix
77     transfMatrixT = np.transpose(transfMatrix)
78     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
79                 range(4)]
80     glLoadMatrixf(matmatList)
81     visualization.draw(meshes)
82     glPopMatrix()
83     glDisable(GL_LIGHTING)
84     drawGrid()
85
86     glutSwapBuffers()

```





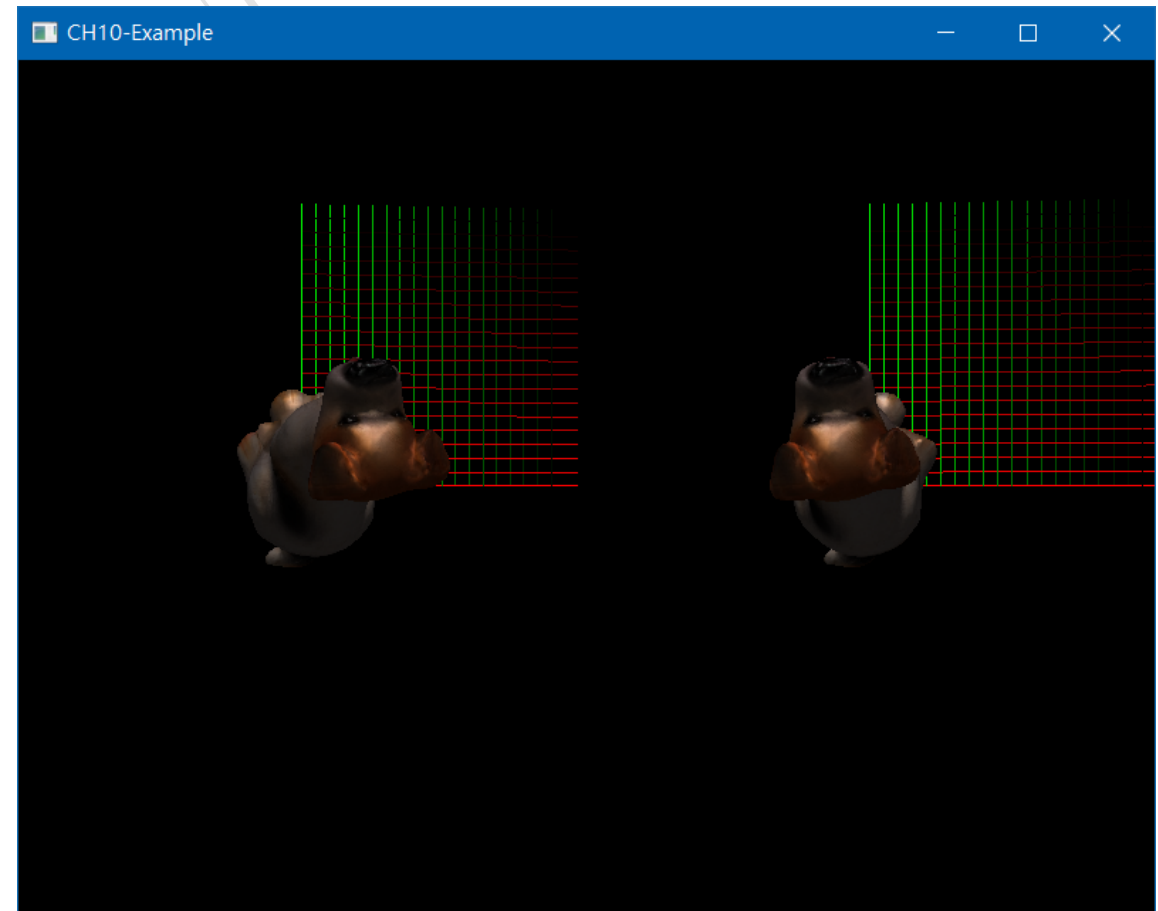
# 1:1 Ratio glfrustum-side by side (with disparity)

## ■ Shift camera's positions (converged configuration)

```

43 def display():
44     glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT)
45     glMatrixMode(GL_PROJECTION)
46     glLoadIdentity()
47     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
48     glViewport(0, 0, int(windowWidth/2.0), windowHeight)
49     glFrustum(-400/2000.0, 400/2000.0, - 600/2000.0, 600/2000.0,
1.0, 5000)
50     gluLookAt(-100,0,1000,0,0,0,0,1,0)
51     glEnable(GL_LIGHTING)
52     glMatrixMode(GL_MODELVIEW)
53     glPushMatrix()
54     global transfMatrix
55     transfMatrixT = np.transpose(transfMatrix)
56     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
57     glLoadMatrixf(matmatList)
58     visualization.draw(meshes)
59     glPopMatrix()
60     glDisable(GL_LIGHTING)
61     drawGrid()
62
63     glMatrixMode(GL_PROJECTION)
64     glLoadIdentity()
65     glLightfv(GL_LIGHT0, GL_POSITION, lightPosition)
66     glViewport(int(windowWidth/2.0), 0, int(windowWidth/2.0),
windowHeight)
67     glFrustum(-400/2000.0, 400/2000.0, - 600/2000.0, 600/2000.0,
1.0, 5000)
68     gluLookAt(100,0,1000,0,0,0,0,1,0)
69     glEnable(GL_LIGHTING)
70     glMatrixMode(GL_MODELVIEW)
71     glPushMatrix()
72
73     transfMatrixT = np.transpose(transfMatrix)
74     matmatList = [transfMatrixT[i][j] for i in range(4) for j in
range(4)]
75     glLoadMatrixf(matmatList)
76     visualization.draw(meshes)
77     glPopMatrix()
78     glDisable(GL_LIGHTING)
79     drawGrid()
80
81     glutSwapBuffers()
82
83

```





色彩與照明科技研究所  
Graduate Institute of  
Color and Illumination Technology

