



Projects for Chapter 2: From Graphics to Visualization

1 PROJECT 1

Based on the code fragments given in Chapter 2, build an entire C++ program that displays the height plot for the Gaussian function described there. Verify your program by compiling it and seeing that the displayed results resemble the ones shown in Chapter 2. Next, incrementally extend your program so that it covers the functionality outlined below:

- Displays the graphs of different 2D functions $f(x, y)$ of two variables. Experiment with three functions of your choice. Describe the difficulties you encountered in getting a good overview of these functions and the solutions you designed to address these.
- Displays the height plot in several modes: smooth shaded and flat shaded (see *e.g.* Figures 2.1 and 2.2 in Chapter 2).
- Displays the grid that represents the sampled domain of the variables x and y underneath the plot (see *e.g.* Figure 2.5 in Chapter 2).
- Allows controlling the position of the light. For this, use either the keyboard, GUI controls (*e.g.* sliders) by incorporating your favorite GUI toolkit in the code, or direct interaction controlled with the mouse.



2 PROJECT 2

Consider the task of displaying the plot of a two-variable function $f(x, y)$, as demonstrated in Chapter 2. To study such a plot, especially in the case of a complex function, one should be able to easily select various viewpoints. Design and implement several mechanisms that allow the following options:

- Zoom out the view so that the entire plot is nicely displayed in the window. This should be achievable by a simple command, *e.g.* pressing a key or mouse button.
- Rotate the plot so that one can examine it from various viewing directions. This should be easily achievable by using the mouse.
- Zoom in to see details of the plot, but do not let the viewpoint get ‘inside’ the plot’s surface.

Hints:

- For the first task (zooming out), consider keeping the view direction fixed, and only changing the eye point location along this direction.
- For the second task (plot rotation), consider whether a free rotation of the view direction adds any value as opposed to a rotation that keeps the up-vector fixed and identical to the plot’s value ($f(x, y)$ or z) axis. Argue your choice.
- For the third task (zooming in), consider computing which is the distance d from a given viewpoint, along a given view direction, to the plot’s surface $f(x, y)$. Once this distance d is known, zooming in should not allow translating the viewpoint along the view direction with a value larger than d . Discuss your solution.

End of Projects for
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