Three-Dimensional Graph Drawing Procedures for Functions of Two and Several Variables

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ABSTRACT

Many functions depend on more than one independent variable. For instance, the volume of a right circular cylinder is a function of its radius and its height, so it is a function V(r, h) of two variables r and h.

Real valued functions of several independent real variables are defined similarly to functions in the single-variable case. In this article, we define functions of more than one independent variable and discuss ways to graph them. But their graph is impossible in the two-dimensional system and the MATLAB program is the language that guarantees computer implementation at a high level in mathematics, easily presenting calculations, images, graphs, and writing programs in its environment.

For achieving this goal, we first explained the plot3 procedure in the three-dimensional coordinate system to draw the graph of two dependent subordinates on the MATLAB program environment, followed by the surf procedure as well as the mesh procedure. Then we explained the procedures mentioned in the polar coordinates. We have provided examples to better understand each procedure.

Keywords- Functions of Several Variables; Mesh methods; surface methods; plots methods.

I. INTRODUCTION

The concept of function was first introduced by a German mathematician, Leibnitz, who was later precisely defined by another world, Euler. The concept of function is included in mathematics science in the eighteenth century and today major mathematical discussions such as limits, derivatives, entrant, differential equations, computational methods, and so on revolve around the properties and developments of the function. In addition, physical rules, high physical accidents, and most areas of technique are explained with the help of subordinates. Finally, one of the most interesting subjects in mathematics, especially in mathematical analysis, is studying the citizenship or relationship of two variables that change simultaneously. That is why we face a lot of problems in all areas of life and the study of science salvation and its progress cannot be done without functions. In other words, the function of mathematics is the criterion for describing the real world. We can write an equivalent, a graph, a numeric table, or a phrase.

A real-valued function f defined on a subset D of R2 is a rule that assigns to each point f(x,y) in D a real number f(x,y). The largest possible set D in R2 on which f is defined is called the domain of f, and the range of f is the set of all real numbers f(x,y) as (x,y) varies over the domain D. A similar definition holds for functions f(x,y,z) defined on points (x,y,z) in R3.

A function f(x,y) defined in R2 is often written as z=f(x,y) so that the graph of f(x,y) is the set {(x,y,z):z=f(x,y)} in R3. So we see that this graph is a surface in R3. since it satisfies an equation

form F(x,y,z)=0 (namely, F(x, y, z) = f (x, y) − z). The traces of this surface in the planes z=c, where c varies over R, are called the level curves of the function. Equivalently, the level curves are the solution sets of the equations f(x,y)=c, for c in R. Level curves are often projected onto the xy-plane to give an idea of the various "elevation" levels of the surface (as is done in topography).

II.   METHODS AND STUDY SITE

We have benefited from library methods and internet resources and the MATLAB computer program in writing this research article. We learned from examples of the method of work in our research article.

## III.   RESULT AND DISCUSSION [IMPLICATIONS]

The graph of a function of two variables is a surface in three-dimensional space. Let's start by looking at the 3-dimensional rectangular coordinate system, how to locate points in three dimensions, and the distance between points in three dimensions.

In the 2-dimensional rectangular coordinate system, we have two coordinate axes that meet at right angles at the origin, and it takes two numbers, an ordered pair (x,y), to specify the rectangular coordinate location of a point in the plane (two dimensions).
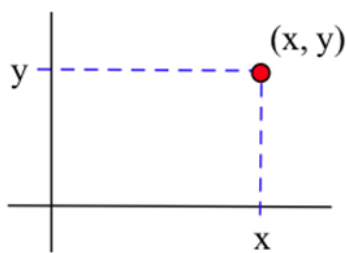
Each ordered pair (x,y) specifies the location of exactly one point, and the location of each point is given by exactly one ordered pair (x,y). The x and y values are the coordinates of the point (x,y).

The situation in the three dimensions is very similar. In the 3-dimensional rectangular coordinate system we have three coordinate axes that meet at right angles, and three numbers, an ordered triple (x,y,z), are needed to specify the location of a point. Each ordered triple (x,y,z) specifies the location of exactly one point, and the location of each point is given by exactly one ordered triple (x,y,z). The x, y, and z values are the coordinates of the point (x,y,z). The figure below shows the location of the point (4, 2, 3).
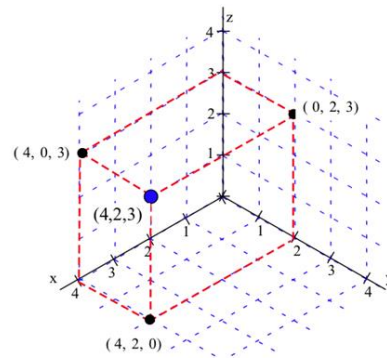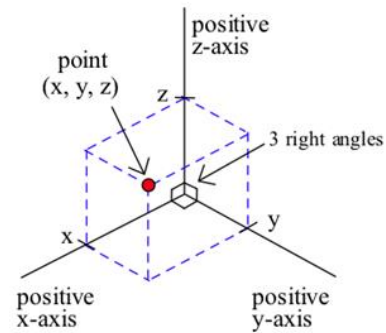

Typically we use a right-hand orientation. To see what this means, imagine your right hand in front of you with the palm toward your face, your thumb pointing up, your index finger straight out, and your next finger toward your face (and the two bottom fingers bent into the palm). Then, in the right-hand coordinate system, your thumb points along the positive z-axis, your index finger along the positive x-axis, and the other finger along the positive y-axis.

Other orientations of the axes are possible and valid (with appropriate labeling), but the right-hand system is the most common orientation and is the one we will generally use. If another orientation is used, then the axes will be explicitly labeled.

Each ordered triple (x,y,z) specifies the location of a single point, and this location point can be plotted by locating the point (x,y,0) on the xy-plane and then going up z units (the red path in the figure below).

We could also get to the same (x,y,z) point in other ways. For instance, we could start by finding the point (x,0,z) on the xz-plane and then going y units parallel to the y-axis, or by finding (0,y,z) on the yz-plane and then going x units parallel to the x-axis (the blue path in the figure below).

Three-dimensional graph-making programs designed for accounting machines and computers can draw the graph of two assigned functions by just pressing a few buttons, and the view from the function graph can be found very quickly to the formula.
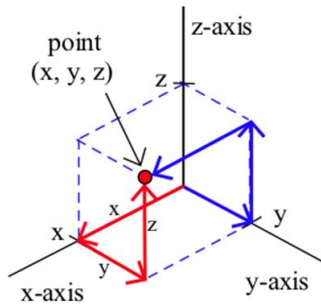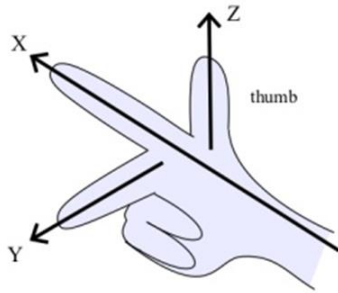
*[*Three-dimensional graph drawing procedures*]*

There are different procedures for drawing a three-dimensional graph in the MATLAB program, each of which shows a level. The procedures used to draw a three-dimensional graph in the MATLAB program include plot3, surf, and Mesh. During this article, each of these three procedures has been reviewed and examples have been presented for each.

*[*Plot3 procedure*]*

This function transfers a two-dimensional curve to the third dimension, resulting in a three-dimensional curve. For example, it creates a circle in the form of a spiral. Plot3 (X, Y, Z) connects the points with the coordinates of X, Y, and Z by a curved line. These three vectors may be algebraically connected or completely independent of each other.

Suppose we want to draw the f(x,y)=10x2+y2 function graph in three dimensions. In the first step, the input change is selected to draw this type of graph of the subordinate in MATLAB. Suppose we want to draw the requested function from the X-axis in the [-1,1] intervener and from the Y-axis in the [0,4] intervener; in this case, the price of the f(x,y) function must be calculated for all points given to the interns located on the X and Y axis.

In addition, a meshgrid in MATLAB is a special procedure for producing internal changes of three-dimensional functions. See if you can use [X, Y]=meshgrid(x,y) procedures to produce x and y internal changes, here, x internal transformations represent the X-axis and y internal transformations represent the Y-axis. Or in other words, if a and b are vectors with n and m elements respectively, the phrase [X, Y] = meshgrid(x,y) consists of equal rows in a row a from X matrix and equal columns in column b from Y matrix. As a result, the x and y metrics will be the same. In the example where we are looking for a solution, we act as follows:

$$>> x = -1: .1: 1;$$
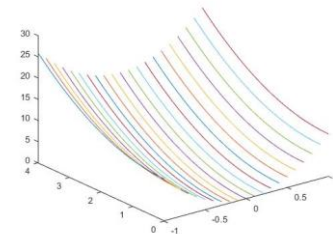
$$>> y = 0: .1: 4;$$
$$>> [X, Y] = meshgrid(x, y);$$

After the production of internal changes, it is now the turn to draw the graph. We use the plot3 procedure to draw the graph and we have the f function to draw the graph that:
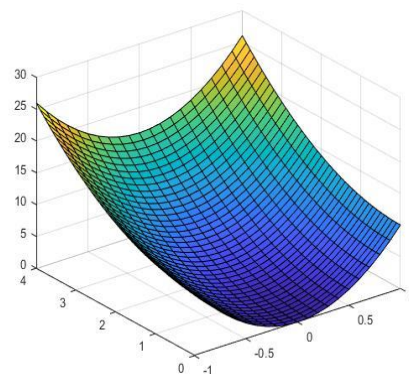

*[*Surf procedure*]*

Another way to draw a three-dimensional graph of a function is the surf procedure in the MATLAB program, in which we should also use the meshgrid procedure for internal changes. After producing internal changes, we can see that using surf procedures, we can draw a three-dimensional graph of the ratio to x and y for the f function. To do this, after entering the data, we have:

[Mesh procedure]

The third method in the MATLAB program is the mesh procedure to draw the three-dimensional graph, using this procedure, such as the previous two procedures, we use the meshgrid procedure. In this procedure, if we have an efficacy function of X and Y in the form of Z, the mesh (X, Y, Z) procedure creates efficacy points with X, Y, Z coordinates and connects it to each other in such a way that efficacy is obtained. For this purpose, we want to insert data into command windows as follows:
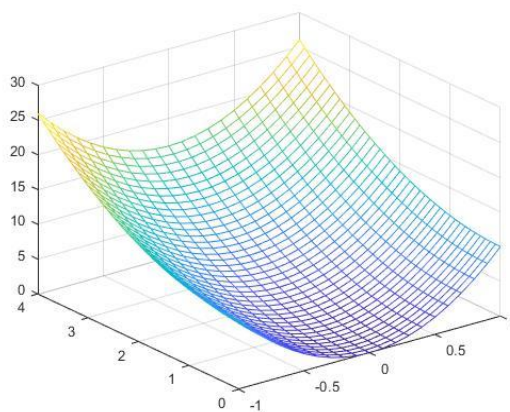

IV. CONCLUSIONS

As the main purpose of this article was to present graph drawing procedures for Functions of Two and Several Variables, we saw that we had drawn graphs in all three ways for the requested function, each graph was different from the other, and the plot3 procedure graph was given as a collection of letters. On the contrary, the level of the function was shown in the surf (f) procedure graph and there was no error in this graph. The Mesh procedure also draws a graph of surf procedures for the requested function, but the graph obtained from the surf procedure is in the form of a syringe.

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