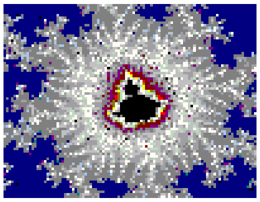


Sinclair Mathnet

October 2008 Volume 15, Issue 1

FROM THE CHAIR

Hello and welcome to Fall Quarter 2008. I hope the new academic year is off to a great start; despite the challenges resulting from the upgrade to Angel 7.2 and the power outage. Speaking for myself, my house was without power for 7 days. Fortunately, the extension cord that stretched from my house to my parent's house, 125 yards away, kept the food in my refrigerator cold!

Even with all the time Al Giambrone spent teaching me about the various aspects of running the department, I was amazed at the many process changes that both myself and Emmilla, the department secretary, had to adapt to in the past year--online requisitions, online payloads, wait-listing, electronic "greenbars." Of course math faculty also had to adjust to a new chair; fortunately they didn't give me too much rope to use to hang myself with. Many changes to the curriculum also occurred this past year. The department revised the way it administers and uses the diagnostic assessments in 101/102, implemented a totally re-designed curriculum in the Math 190 sequence, five new online classes were offered over the course of the year, work had started on the OLN grant to "revision" Math 101 to allow a more flexible approach to learning, a Math for Artist grant was approved, Tablet PCs were used to teach online classes as well as a section of Math 192, and "clickers" have been incorporated in certain Math 190 sequence classes.

As the above paragraph indicates, a lot of time, money, and thought have gone into the restructured Math 190 sequence. Are students successful in the Math 190 sequence? Based on a recent study done in the spring of 2008 by Research, Analytics and Reporting, it appears that students are succeeding in the Math 190 sequence. For example, for the last academic year the "average" success rate of the Math 101/102 sequence was 41.4%, while for the Math 191/192/193 sequence it was 58.9%. In fact, for Spring of 2008, the success rate in Math 193 was 64.4%! Please note that total enrollment in Math 193 last spring was only 73 students. Nevertheless, think of the possibilities!

Next Steps?

As a result of the improved success rates in the Math 190 sequence, the department plans to officially include the 190 sequence as part of its course offerings so that Math 191, 192, and 193 appear in the college catalog. The department also plans to do more to "get the word out" about the Math 190 sequence classes to students, since enrollment in the sections tend to significantly lag enrollment in Math 101/102. Further, the department will continue offering the Math 101 "revisioning" sections this winter and spring; success rate data on this new pilot should be available during winter quarter. Additionally, one section of Intermediate Algebra will also be offered Winter Quarter 2009 as part of the Math for Artist Grant. This section will be taught by Marie Stroh using techniques and visual aids geared to help visual learners develop a better understanding of algebra.

In the next issue of *Mathnet*, I plan to share some results of final exam data comparing Math 101/102 to the Math 190 sequence. As related above, this past academic year success in the Math 190 sequence classes has been consistently higher than when the pilot was first introduced, and higher than in Math 101/102. Given the improved success rates in the Math 190 sequence, some important questions to be considered in the next issue are, "What aspects of the improved structure in the Math 190 sequence are causing the improved success rates? And are students in the Math 190 sequence learning algebra better than their counterparts in Math 101/102?"

Tony Ponder ■

An Application of Analytic Geometry to Designing Machine Parts–and Dresses

by
Karl Hess

This paper presents the solution of an engineering problem that the author was asked to solve. The problem involves creating a flat pattern that could be cut from a piece of sheet metal and rolled to form a tube whose top edge would be contained in a plane that is not perpendicular to the central axis of the tube. A piece of this nature needs to be fabricated whenever two sheet metal tubes must be joined at any angle other than a straight angle.

My brother-in-law called me with an intriguing yet surprisingly simple problem one evening about 20 minutes past 11:00. It was not the first time he had called me looking for help with a math problem, nor the first time that he had called me so late. Still, I was tired, and more than a little annoyed with him. Despite that, being asked for help with a problem has always managed to touch a little corner of my mind that is quite proud of being a mathematician. So I listened.

James is a mechanical engineer who works for a firm that designs commercial bakeries. In the course of redesigning a machine that was not working properly, he had found it necessary to have a tubular part which would be fabricated by rolling a piece of sheet metal into a cylinder. What made the situation challenging was that one end of the tube needed to be cut at an angle that was not perpendicular to the central axis of the tube. It's much easier to cut a piece of sheet metal while it is still flat, so James wondered how he would need to cut the top so that it would have the form he desired after the sheet was rolled into a tube.

James is accustomed to relying on AutoCAD to find the necessary geometric properties of a design. In this case, he was at a loss as to how to apply this software. So were the engineers that he works with. Fortunately, years of mathematical training as an engineering student had left him with the ability to recognize this as a problem in analytic geometry. He just wasn't quite sure how to proceed.

After James had explained the problem to me, he asked whether the appropriate curve might be found by describing the tube with an equation and finding its intersection with a plane having the correct slope. I had had the same initial thought almost immediately after he explained the problem. Just as quickly, I had encountered the same problem that was perplexing him. While it is easy enough to describe the intersection of a cylinder and a plane with parametric equations, neither of us could see what would happen to those equations if the intersecting curve were "unrolled" onto a plane.

After realizing that I didn't know how to "unroll" the curve, I decided to give some thought to what I was really trying to find. All I needed was a function describing the curve as it would be when the sheet was flat. It occurred to me that in this state, it might very well be possible to describe the curve with a two-variable formula, where the variables represent rectangular coordinates. For reasons that should seem clearer later on, I will call the variables s and z rather than the more standard x and y. The variable s measures horizontally along the bottom of the sheet from the bottom-left corner. The variable z measures from the bottom of the sheet up to the curving top edge. The trick is to find the connection between s and z.

Since our flat sheet is just an unrolled tube, the total horizontal distance along the bottom would simply be the circumference of the tube. (This is why I chose to use *s* for distances measured along the bottom of the sheet. They are really arc lengths.) I double-checked with my brother-in-law to make sure that no overlap was necessary in the construction of the tube. There wasn't. The seam was to be bonded with a weld. Therefore, an *s*-value measured along the bottom of the sheet would correspond to an arc length measured along the bottom of the tube starting at the seam. If you construct the tube by rolling the edges up and making the seam on the side closest to you, then the s-values along the bottom of the sheet correspond to an arc length measured clockwise. If you construct the tube by rolling the edges under the sheet and making the seam on the side farthest from you, then the *s*-values along the bottom of the sheet correspond to an arc length measured counterclockwise. Either way, you get the same tube. We'll assume the tube was rolled so that the arc length can be measured counterclockwise. That way, the corresponding central angle in the middle of the tube is positive. We'll use θ to represent the central angle in the tube corresponding to *s*.

Now, assuming that θ is measured in radians, we can say that $\theta = \frac{s}{r}$, where r is the radius of the tube. The radius would be a design parameter, so we can treat it as a constant. Therefore, this formula gives us θ as a function of s. The chain of compositions that will take us from s to z is now underway.

This article is an excerpt from K. Hess, "An Application of Analytic Geometry to Designing Machine Parts – and Dresses," *Elec. Proc. Undergraduate Math. Days*, Vol. 3 (2008), No. 5, 6 pp.

The full article may be found at http://academic.udayton.edu/EPUMD/.

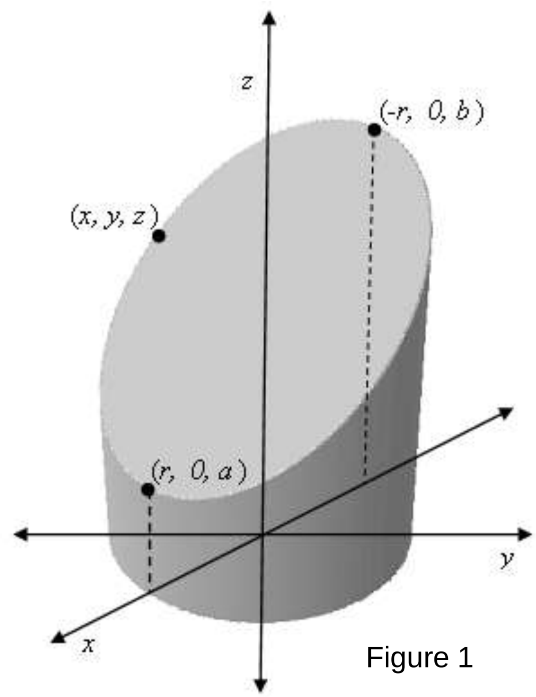


Figure 1

Let's place the rolled-up tube into a right-handed three-dimensional coordinate system. (See Figure 1) We'll let the *z*-axis be the central axis of the tube, and put the bottom of the tube in the *x*-*y* plane. We'll put the slanted top of the tube above the *x*-*y* plane. Also, I want the shortest portion of the top edge to be directly above the positive *x*-axis. This last condition wouldn't be absolutely necessary to construct the tube. Here's why I'm including it. The central angle θ is measured counterclockwise from the positive *x*-axis, so the arc length s is also measured from the positive *x*-axis. In the unrolled state, s is measured from the side of the sheet. The side of the sheet is where the seam of the tube will be. Therefore, this positioning puts the seam of the tube in the place where it will be the shortest. Since the seam has to be welded, this seems like the logical place for it.

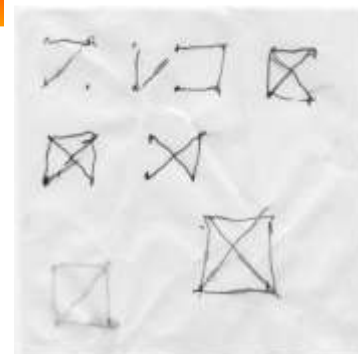
(End of Part I)

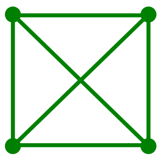
We now pause to give the reader the opportunity to solve this problem on his or her own. The solution will appear in the next issue of Mathnet with the remainder of Karl's article.

Test Your Skills

By Lyn Keeler

Those of you who took a Graph Theory course while in college or who have taught Math in the Modern World will recognize the problem that my husband encountered while working in the garden this summer. We have a very tall cactus plant that needs support, and over its lifespan we have used a variety of stakes, wire and string to hold it upright. The latest scaffold consists of rebar and string. Mark's question was whether he could tie string between the four poles and across the diagonals without stringing the same section twice. (See his attempts at right.)





Exercise: Determine whether the graph at left can be traced without lifting your pencil from the paper and without using any edge twice.

DEPARTMENT RETREAT

The group shot above was taken at the Department Retreat on August 28th at the Bergamo Center. The full day retreat featured sessions on Algebra In-class Activities, Distance Learning, Communicating Student Expectations, Handling Difficulties with Students, the TI-nSpire and Tablet PCs, the OLN Grant and the 190 Sequence. In addition, Tom Wilson led the group through a Myers-Briggs type Indicator that gave us insight into our own personality types and appreciation for how team dynamics can be strengthened by knowledge of how these types interact.

For copies of the handouts used at the Retreat, see Mathematics Community Group on Angel under "Content."

Harvey's Joke Corner

"Ballo" – a special name for an absentee ballot.

My car is so old that the odometer displays scientific notation.

Before exams, students purchase "high test" coffee.

Math department phone number: 2^9-2767.