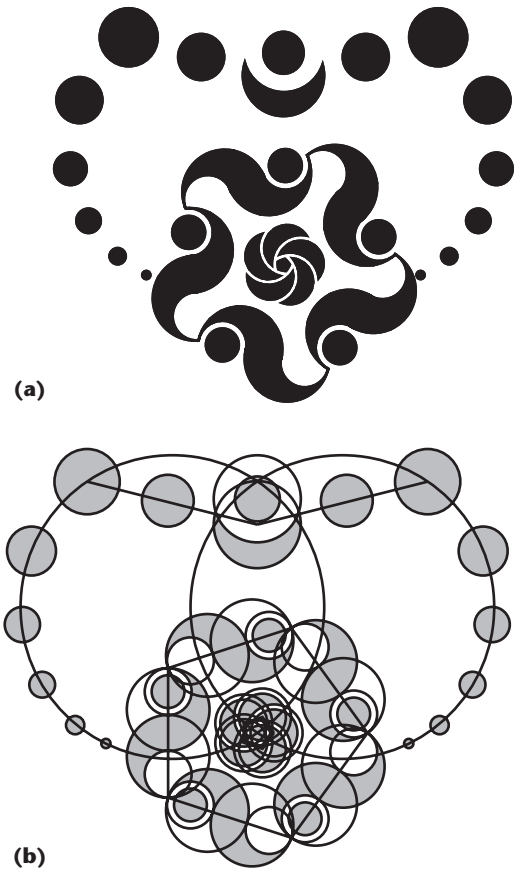
Andrew Glassner's Notebook

Crop Art, Part 3

Andrew Glassner

This column wraps up my three-part series on crop circles and crop formations. In Part 1 (from the September/October 2004 issue of *IEEE Computer Graphics and Applications*), I talked about the history of crop circles, and the people who make and study them. I also presented the strange story of the five Hawkins Theorems, and showed how to construct the basic geometrical skeleton for a crop design. In Part 2 (from the November/December 2004 issue), I presented my *Crop* language for representing many crop patterns in a compact form.

In this installment, I'll discuss an original design I made using Crop, and tell the story of how two friends and I created that design over the course of a single wet Sunday.



1 (a) Design for the first two sections of my parking-lot formation. (b) Design schematic.

Case study

There's an old aphorism that says, "In theory, there's no difference between theory and practice. But in practice, there is." I decided to put theory into practice and actually create a crop circle.

When I began this project, I had a small problem with timing and location to overcome, because it was the middle of winter. There simply aren't many crops of mature wheat to stomp down near Seattle in the winter. A friend and I considered a number of possible alternative canvasses, including a flat beach at low tide and a snow-covered frozen lake. Creating a formation in either of these locations in the middle of winter would have been very unpleasant from a comfort point of view.

Then my friend had a brainstorm: he managed an outdoor parking structure that needed to be cleaned. A couple of years of dark grime and dirt had accumulated on the exposed top floor, and it needed to be pressure washed. The high-velocity water shooting out of the nozzle of an industrial pressure washer would dislodge the layers of dirt, revealing the lighter colored, clean concrete underneath. We realized that this was a great opportunity: we could create our art, and also give him a head start on cleaning the parking deck.

We scouted the site, walking and measuring. There were several concrete planters that broke up the space, and they each contained trees that blocked the parking deck's visibility. I eventually selected a large area between the planters that was mostly visible from an upper floor of a nearby building.

The next step was to create the design. Three of us would be working on the formation, but we had only one pressure washer, so only one person could actually be spraying away the dirt (our analogy to flattening crops) at a time. We also wanted to get the project done between about 9 a.m. to 1 p.m. I needed to create a design that would give me good experience with this process, yet not require too much time or precision to realize. I decided to make a three-part design. We'd build it in stages, and stop when we ran out of time.

Figure 1a shows the three-part design: a ring of nested crescents, surrounded by waves, hung on a necklace of circles. Figure 1b shows the underlying schematic. Figure 2 provides the Crop code for this design. I've left off the code for the circles on the necklace because there's nothing interesting about those specifications. (It's just a list of `trope` commands that locate one circle after another.)

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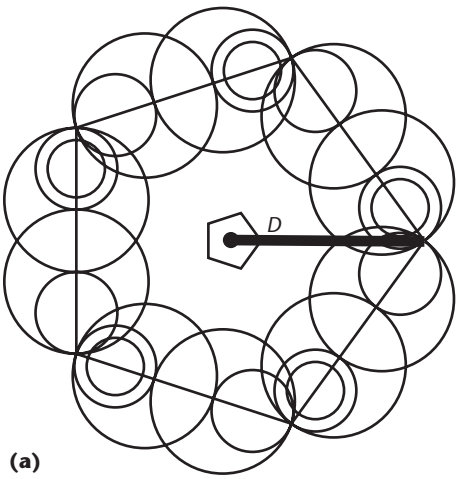
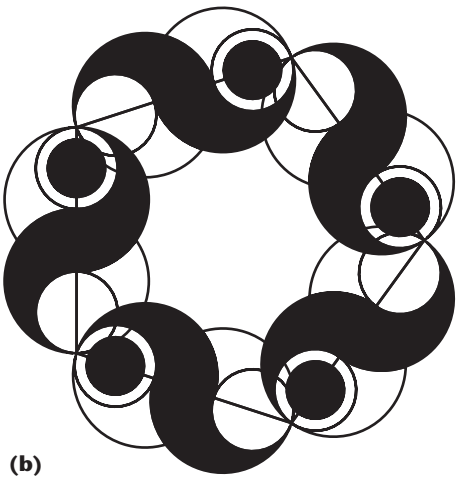
```
// Parking circle formation
// (c) 2004 Andrew Glassner
 58 A name
 81 B name
 99 C name
382 D name
143 E name
 81 F name
 57 G name
// Create center crescents
[
  V0 < B C > circle
] # 5 A 0 ngonloop
// Create outer waves
# 5 D makeNgon P1 name
[
  P1 V0 E pwalk < E > circle
  P1 V0 F pwalk < F > circle
  P1 V1 -E pwalk < E > circle
  P1 V1 -F pwalk < F G > circle
] # 5 D 0 ngonloop
```

2 Crop code for my parking-lot formation in Figure 1. All of the distances assigned to the letter-name variables are in inches.

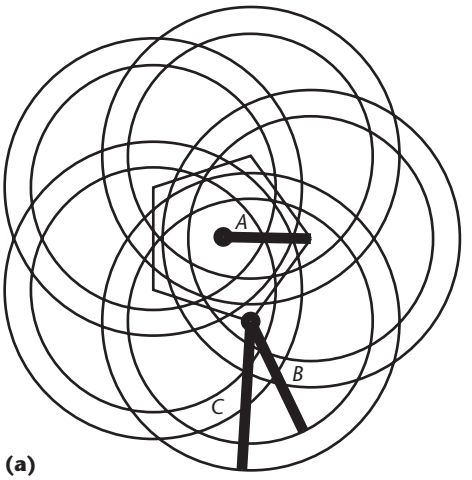


(a)

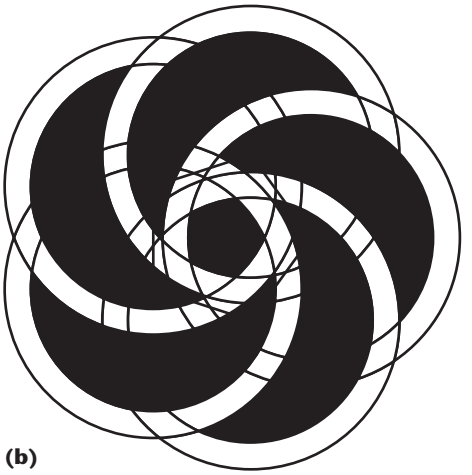


(b)

4 Geometry of the waves surrounding the design's center, created by the second loop in Figure 2.



(a)



(b)

3 Basic geometry of the design's center, created by the first loop in Figure 2.

In this code, I first identify all the distances by name, for convenience. The first loop creates the 10 circles forming the center design of nested crescents. Then I create a large pentagon called `P1`. The next loop creates five circles that lie on each edge of `P1`.

The next few figures show how the Crop code matches up with the geometry. Figure 3 shows the framework of the inner crescents. Note that the core pentagon on which the circles are formed isn't part of the final design, but is just a construction tool.

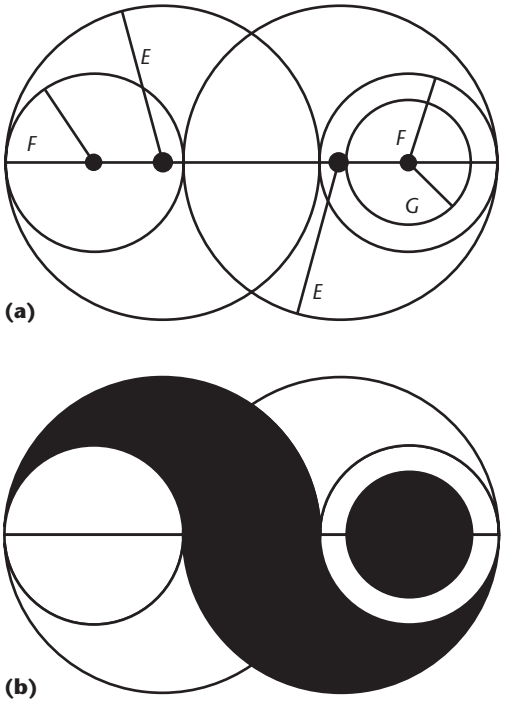
Figure 4 shows the basic construction for the waves part of the formation. Once again an underlying pentagon forms the skeleton, and the other circles are hung off of it. Note that the circles are placed along the pentagon's perimeter using the `pwalk` command.

Figure 5 (next page) shows a closeup of one wave formation. I've isolated a single side of the pentagon and shown the five circles that get drawn along it.

Reality sets in

I made a handout for each of the team members that boiled down the essential geometry and steps for creating each design element.

The day before we were to make the design, we put together our essential supplies: chalk for marking circles and key points (since we didn't have any crops to



5 Five circles built on each side of the pentagon in Figure 4. These make up the waves around the formation's center.

6 One big dot: our first circle and the unwashed canvas behind it. This is the large circle in the upper left of Figure 1. The pressure washer is sitting to the dot's right.

flatten), cloth surveyor's tape (much easier to manipulate than metal tapes), earplugs (pressure washers are loud), pens and paper, and miscellaneous additional items (extension cords, colored tape, drinking water, snacks, and so on).

When we gathered at the site to start working, the parking lot was wet from the previous night's rain, but at least it wasn't raining at that moment. We all agreed that we were glad to have a dry day in which to work. Such optimism. I wanted to start with a simple shape, just to make sure that this whole plan made sense. We decided to make one large circle that belonged to the upper-left part of the necklace. This would give us experience using the pressure washer and would confirm that the clean and dirty parts of the concrete would result in enough contrast so that the final design would be visible. In the process of making the circle we found that (of course) this was going to take much longer than we had thought.

First, the pressure washer's nozzle was only about 4 inches wide, so each pass of the pressure washer could only clear a stripe of that width. Second, really getting rid of the grime required two and sometimes even three passes with the washer. Finally, getting a nice sharp edge around the circle meant going slowly, because the pressure washer was difficult to control with all that water shooting out of it. But we eventually cleared the circle, and looking down on it from a nearby building we felt there was enough contrast so that the project was properly visible. Figure 6 shows our view of the one big dot and the parking deck behind it where we would place our design.

We returned to the parking deck, broke out the tape and chalk, and started to measure out the pentagon at the heart of the design.

Hands and knees

Drawing the circles turned out to be far more difficult than I had anticipated. One person held the surveyor's tape at the center of each circle. The other person (that was me) crawled on hands and knees, holding the chalk tight against the tape, keeping the tape taut, drawing the circle on the ground. Crawling around on concrete is no fun, and we didn't have kneepads or other gear to make it more palatable. Not only is it a surprisingly slow way to work, but it's physically painful on your back to be bent over and crawling over what quickly starts to feel like enormous distances.

Necessity gave birth to invention: chalk on a stick. We simply taped a piece of chalk to one end of a broom handle and taped the surveyor's tape next to it. Then we were able to walk around the circle, pulling against the tape and leaving a line behind. We realized once we'd made this device that surveyors have a tool just like this, complete with a little wheel on the bottom and a self-feeding chalk mechanism. But the jury-rigged version worked great, and we were marking circles much more quickly and with less pain than before.

We marked out all five of the larger circles in the inner part of the design and started marking the smaller ones. Once we had a couple of these drawn on the ground, it was time to start pressure washing.

The ground now looked like Figure 3a. There were dozens of distinct curved regions of different shapes. Which ones should get cleared away?

Looking at this maze of lines on the ground was confusing. Since it was impossible to erase (just like in a field, once we'd washed clean a part of the deck, it was going to stay clean), it was critical that we knew which regions of these overlapping marks should be cleaned and which should be left alone. A single mistake would ruin the whole design. I took a deep breath and chalked a big squiggle inside each segment that should be cleaned. We fired up the pressure washer, and while one of us slowly blasted away the grime, the other two marked circles for the waves.

Then it started to rain.

Happily, we were all Seattle locals, so we had our rain gear ready. But our chalk on a stick didn't fare as well, since the rain soaked the tape, causing the chalk to constantly fall off. Additionally, the pressure washer removed not only the grime it was pointed at, and any chalk immediately under it, but the spray from the washer also eroded nearby chalk marks which were needed for later sections. So whatever chalk had managed not to be washed away by the rain was getting blown away by the pressure washer. We found that we often had to go back and touch up the circles, staying just a few minutes ahead of the person working the pressure washer. We usually tried to blast away the edges of each segment of the design first, and then we could more quickly clear away the dirt inside the regions. Figure 7 shows the job in progress during a dry moment.

We had intended to stop at about 1 p.m., but we had just started on the outer pattern of swirls at that point, and everyone wanted to continue. Another friend came to visit us, and as two people went off to retrieve lunch, the other two kept chalking and washing.

Then it started to rain harder.

Now we were trying to make chalk marks on regions of the parking deck that were literally underwater. Sections of the parking deck formed little depressions or bowls without drainage, so we tried to make chalk marks on the bottoms of puddles two or three inches deep. Of course, the chalk washed away as soon as it scraped against the ground, and all we achieved was tinting the puddle a delicate shade of yellow. Back on hands and knees, we ground the chalk hard into the concrete just to get a faint smudge of color. This had the side effect of rapidly wearing away our chalk supply, so what had originally seemed like an embarrassing oversupply of chalk was quickly reduced to a handful of little pebble-sized pieces that we had to treat like nuggets of precious metal, which we ground into the concrete with numb fingertips.

Around 4:30 p.m. the sun was starting to set, but the rain stopped. We started working faster with the pressure washer, now trying to get the design at least clean enough to be visible. About 20 minutes after sunset we finally got the last of the swirls completed. Visibility was dropping fast, so we packed up quickly. When we were done it was too dark to even see the design, so we left the site and drove home with no idea of what our work looked like.

A few days later my friend and I returned to the site with our cameras, and I took the picture in Figure 8 as he posed. You can see a region near the back where unevaporated water is still covering up much of one of the white circles; this is one of the places that was completely underwater when we worked on it. Nevertheless, I'm happy with the result. We managed to make the design I'd created without significant errors, it fit in the space, the Crop code worked perfectly, and we all remained friends throughout the process. That's a pretty good record for a piece of collaborative art!

7 Pressure washing the parking deck during a rare moment when the rain stopped. Note the small width of the spray coming out of the nozzle. Because of the glare and the reflections off puddles in this image, it's hard to see where the ground has been washed and where it hasn't.

8 Photograph of the completed formation in Figure 1.

Wrapping up

In this column I've only scratched the surface of the subject of crop circles. Almost every aspect of this phenomenon—from the cultural and social to the practical and geometric—gets more interesting the more you look into it. For more information, I encourage you to check out some of the references listed in the first two installments of this column.

Crop art is a fascinating social phenomenon, and an interesting application of geometry. If, like me, you find yourself drawn into making crop art of your own, then it becomes an expressive medium in its own right. ■

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