Don Lancaster's

Tech Musings

June, 1995

There's been some new books lately that you might find of value. *Lindsay Publications* has just freshly republished dozens of titles. Mostly as reprints of fascinating or "lost" technology from long ago and far away.

Ferinstance, a horse's mouth 1935 *Neon Signs* book. Authored by Miller and Fink. A nine volume *Cyclopedia of Formulas*. Initially published by *Scientific American* at the turn of the century. Secret processes for nearly everything from chemistry to dyes to electroplating to artist's materials to chewing gum to photography.

One new book I have personally found very useful is one that involves some really hairy math. We looked at *Bezier* curves and cubic splines back in HACK62.PDF and in the *Hardware Hacker* hard copy reprints. Splines are the secret to using sparse data to generate graceful two dimensional curves or 3-D surfaces.

A difficult but definitive new book on splines is called *Knot Insertion and Deletion Algorithms for B-Spline Curves*. It shows the tricky process of breaking a curve up into any number of subcurves. Or finding any points along a single curve. Or combining a pair of curves into a longer one.

Hundreds of references to earlier spline papers are also given. Authors are Goldman and Lyche. Published by SIAM, the *Society for Industrial and Applied Mathematics*.

Fibonacci's Golden Sunflowers

Have you ever marveled at how a sunflower's seeds are so compactly arranged along such mathematically precise spirals?

So have several botanists. Who are now questioning just how much of a plant's growth is set by genetics, and how much gets determined by math algorithms and physical laws.

A fine (but heavy) book on this is *The Algorithmic Beauty of Plants* by Prusinkiewicz & Lindenmayer. From the *Springer-Verlag Press*. A popular summary did show up in *Scientific American* for Jan 95, pp 97-99.

There is some hairy math behind the seed arrangements. But math that is easily explored with the PostScript computer language. So, figure one shows you the fundamental algorithm that draws the seed arrangements.

Actually, those spirals are visual *artifacts* that have nothing to do with the underlying generation algorithm. What you see are the *results*, and not the original cause.

What you do instead is start a very tight spiral. One that is not obvious. Then, for every 137.50776 degrees of rotation, you plant a seed.

That's all there is to it.

Well, maybe not quite all. Do this and the seeds get further and further apart as you go away from the center. So, instead, you gather together your outside seeds using a value that I will call the *divergence*.

A divergence of 1.0 does nothing. It leaves your seeds spreading out. A divergence of 0.5 exactly gives you a uniform result. As shown here.

Another way of looking at the 0.5 divergence is that it moves each seed towards the center by the *square root* of its radial distance.

In real sunflowers, all the outside seeds do tend to be larger and spacier than most inside ones, so the actual plant diverges by 0.6 or so.

For some wild artistic effects, try a divergence of 0.3.

That value of 137.50776 is critical and has to be exact. This is a magic irrational number that's got all sorts of artsy-craftsy uses. It's even related


```
/golden 137.50776 def            % super dooper magic number.
/rate 18 360 div def             % base spiral expansion rate
/divergence 0.5 def              % exponent - 1.0 is linear, 0.5 is best
/sweep 160000 def                % total number of degrees in spiral
/inside 60 golden mul def        % size of hole in middle
/dotrad 0.2 def                  % size of seeds

/dot1 {newpath dotrad 0 360 arc fill} def   % dot utility routine
/fixpack {dup 0 ge {divergence exp} {neg    % packing utility routine
    divergence exp neg} ifelse} def

/drawsunflower {inside golden sweep {        % start for loop
    dup dup rate mul fixpack                 % copy vector
    exch cos mul exch dup                     % find & save x position
    rate mul fixpack exch sin mul             % find y position
    dot1 } for } def                          % draw dot; end loop & proc

drawsunflower                                 % draw the sunflower
showpage quit                                 % and print it
```
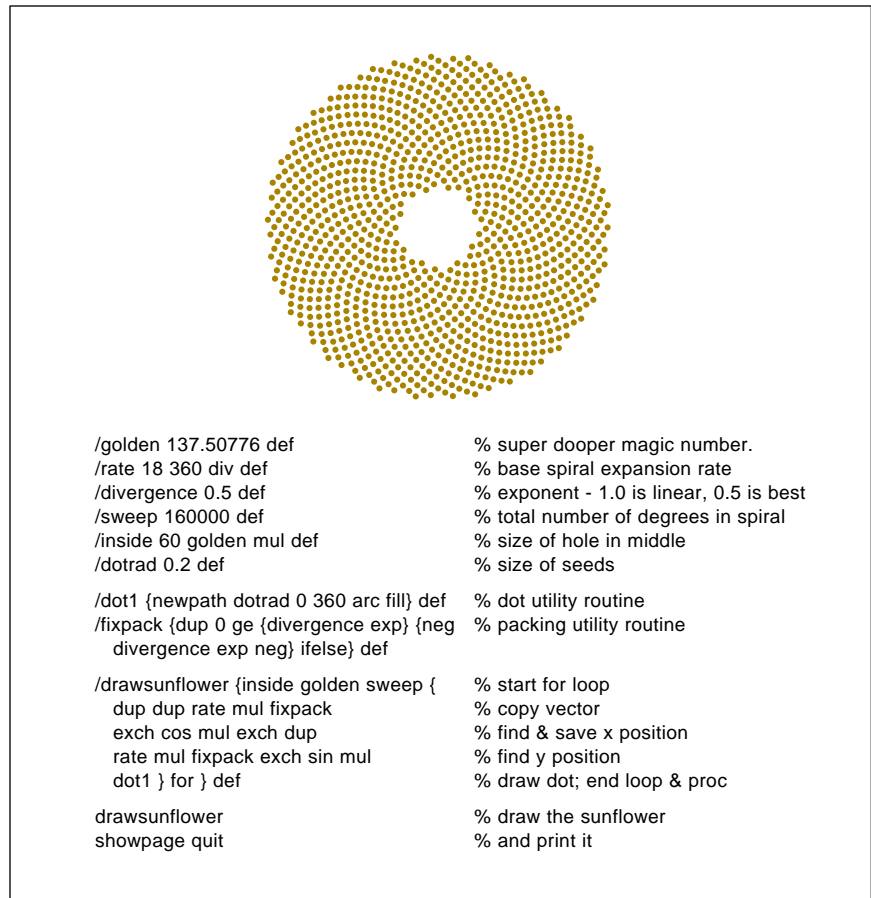
Fig. 1 – FIBONACCI'S GOLDEN SUNFLOWER is easily modeled with this simple PostScript routine. Many variations are possible.

A mathematical **SERIES** is just a sequence of numbers. If you are given the early numbers and a set of rules, you can generate the rest of them.

Two obvious series examples are the **LINEAR SERIES** of 1, 2, 3, 4, 5, 6, 7 … and the **SQUARE SERIES** of 1, 4, 9, 16, 25, 36, 49, 64….

A sequence called the **FIBONACCI SERIES** results when each new number is made from the sum of the previous two…

1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144…

Fibonacci sequences occur quite often in nature and in physical systems. The spiraling clockwise and counterclockwise sunflower **PARASTICHIES** are often two adjacent numbers in the Fibonacci Series. Such as 34 and 55.

The **LIMIT** of the ratios of sequential Fibonacci numbers is 0.618034. This is related to the Greek's **GOLDEN RECTANGLE** and is also precisely 137.50776 degrees around a full circle.

Fig. 2 – THE FIBONACCI SERIES often appears in natural systems.

to the Grecian *golden rectangle.*

It turns out this magic number is also the limit for paired numbers in a *Fibonacci Series*.

Figure two gives us a few clues as to what Fibonacci was up to.

A Fibonacci series gets created by making each new term out of the *sum* of its two previous ones. Such as 1, 2, 3, 5, 8, 13, 21, 34, 55, 89….

Or a related *alternate series* of 3, 4, 7, 11, 18, 29, 47, 76…

A surprising number of real-world physical processes tend to do things in a Fibonacci manner. Ironically, the Fibonacci series did *not* work for the thing that Fibonacci developed it for in the first place.

As you continue to take the ratios of higher and higher paired Fibonacci numbers, you *converge* on a value of 0.618034. And that percentage of the way around a 360 degree circle is, of all things, 137.50776 degrees.

And the inverse of that number is the Greek's golden rectangle!

Those spiral artifacts are known as *parastichies*. They usually end up as two adjacent numbers in a Fibonacci series. Or, in the case of figure one, spirals of 34 and 55.

To make the clockwise "34" spirals a tad more obvious, reprint the figure larger with higher divergence.

Uh, the inside of the spiral doesn't start off all that great. So, I simply blanked it out. Note that many real sunflowers do the same thing!

To run this code, just enter it into your word processor and send it to any PostScript printer. By using any comm program or clicking the "send PostScript file" on a printer driver. Or else use *GhostScript* instead for on screen viewing.

More details in STARTUP.PDF.

Then change the parameters to get different patterns. I have summarized this algorithm in figure three if you want to translate into a less useful or more primitive language.

I've posted ready-to-run code as SUNFLOUR.PS on *www.tinaja.com* For another mind blowing example of algorithm driven growth, upload FRACTFERN.PS as well.

Elegant Simplicity Strikes Again

I have just been snooping around inside of *Radio Shack's* new 22-103 *A.C. Voltage Sensor* product.

This is a really great toy. This pen sized device lights up anytime it gets within an inch or two of any live 110 volt AC source. Simply hold it *near* a line cord to make sure the power is available. Or trace hot wires through the walls of your home.

Or quickly check fuses or circuit breakers. Or run "hot chassis" safety tests. Or replace series Christmas tree lamps. Or make darned sure power is off before any repair.

A simplified schematic is shown in figure four. What you have here is basically an E-field radio receiver for 60 Hertz power line radiation.

Amazingly, most of the work gets done by a ten cent hex inverter!

The first inverter is biased into its active region so it behaves as a linear amplifier. To the metal tab antenna, this looks like a gain of ten amplifier with an 8 megohm input impedance. Four more cascaded inverters act as a high gain clipping amplifier.

In the presence of a strong enough ac electric field, a 60 Hertz square wave current appears across the LED, brightly turning it on.

A resistor to ground on the output of their first inverter introduces the slight bias offset to make certain the *second* inverter will remain off in the absence of a 60 Hertz signal. Your sensitivity threshold can be adjusted by changing this resistor.

The capacitor handles two tasks. It should bypass any 60 Hertz negative feedback to give you the maximum ac gain from the first stage. Plus, it gives you a free battery check when it takes a fraction of a second or so to charge up on power on.

More elegant simplicity at work.

The circuit board has options for a buzzer and several other operating modes. Note that the two "mystery resistors" are low-ohms jumpers.

Two tips if you build your own: A sensing antenna *must* be bare and exposed for maximum sensitivity.

And do be *certain* to use the less common -UB *unbuffered* version of the hex inverter. A stock 4069B has too much gain and will oscillate.

The drive transistor can probably be eliminated if you go to a higher supply voltage and a high brightness LED. Naturally, the device will not work at all if there is shielding, BX cable, conduit, or metal between you and your traced wire. And, of course,

(1) Start a long and tight spiral path.

(2) Every 137.50776 degrees, plant a seed.

(3) Optionally shift seeds towards center.

Fig. 3 – THE SUNFLOWER ALGORITHM.

only *active* hot wires can get traced through house walls.

More details on CMOS linear amps in my *CMOS Cookbook*.

Adobe's Acrobat

Which is better for you: A printed document or an electronic one?

Nothing, but nothing can compare to the "touchy-feely" vibes of real ink or toner on real paper. Especially its legibility, its pride of ownership, or its "read it anywhere" use ease.

If these are important to you, there is simply *no way* that *any* electronic document could come even remotely close. At least it is not gonna happen in the next five years or so.

On the other hand, an electronic document is instantly available. It is never misplaced or "out on loan". It gets easily corrected or updated long after it is first published. All copies are perfect originals. There is never any generation loss.

Electronic documents do not wear out or deteriorate through time. No mustard stains. They are stored in far less space and are easily customized.

They can get shipped ridiculously faster at much less cost.

Electronic documents can provide *hypertext* features that are simply not available on the printed page. Such as rapid searching. Even for sloppy keywords over groups of documents.

Or entire libraries.

One mouse click on an index or a table of contents or a link instantly gets you to the right page. Or shifts you to some related references. Or gives you tutorial help.

Or plays music. Or runs a video clip. Superb nonlinear access.

You can have mini *thumbnails* that let you view many pages on screen at once. Or let you add "post-it" *notes* that never fall off.

In real life, you will require both the electronic and printed documents.

That much is totally obvious.

Newly upgraded *Acrobat* software from *Adobe Systems* offers you the best of both worlds. Acrobat is fast becoming the new Internet de-facto standard for document interchange. The good news is that you can now *device independently* view superb quality *real* documents right on your computer screen. And the best news of all is that Adobe's Acrobat is *free*
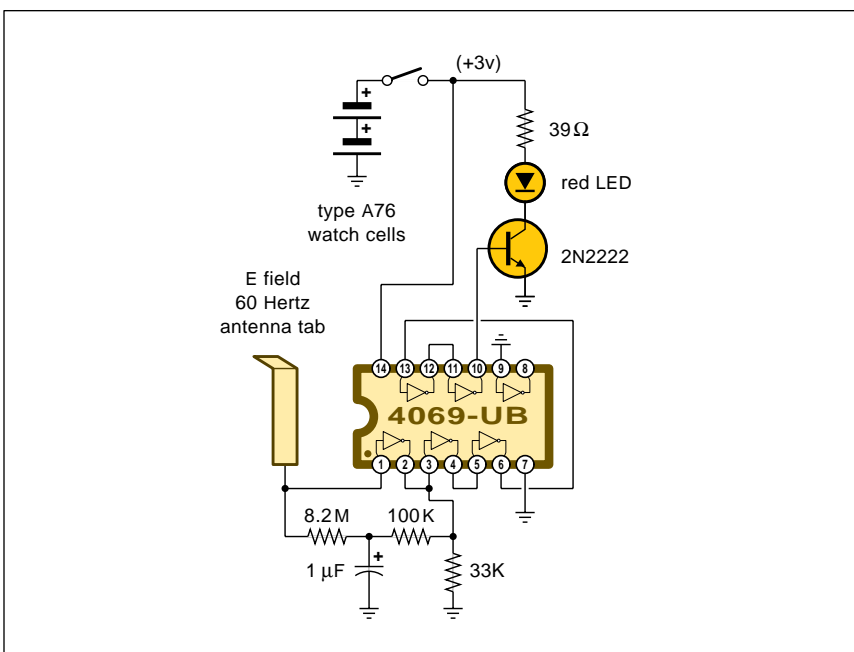

Fig. 4 – SIMPLIFIED SCHEMATIC of the Radio Shack 22-103 ac voltage sensor. The circuit is basically a 60 Hertz e-field radio receiver.

to the end document user!

The key to Acrobat is a compact file called a .PDF file. These files use only ASCII printing characters. Thus they are compatible with all comm channels. The *Acrobat Reader* lets you view the documents on screen, wander around in them, search them, or print them out.

Acrobat files are created internally by applications, or else by using an *Acrobat Exchange* utility code. The separate *Acrobat Distiller* program converts pretty near any PostScript file into a compact and lean "just the facts ma'am .PDF format.

An acrobat file conveys mixed text and graphics. Including words, line art, and photos. Just like the printed page. Plus optional sound, video, or even a robotic control. Plus all those

hypertext goodies overlaid on top of everything.

How are oddball fonts handled? If you absolutely *must* have an *exact* duplication, then a .PDF file will tow along all of your needed fonts. This does make the file rather long, but it guarantees complete accuracy.

For typical users, unusual fonts get substituted by *multiple master* fonts. One serif, one sans. These are "good enough" for most users most of the time. The multiple master font has variable width, weight, and optical size. Yes, your layout and exact text justification is fully preserved. So are most of the document's vibes.

Usually, the Acrobat reader shops around for real fonts, first checking host and printer, and then the .PDF file itself. It uses these if available; otherwise a multiple master font gets substituted as a stand-in.

For cases where you only need a few letters of some oddball font, you could capture your font path ahead of time. Giving you exact results *and* a short file length at the same time.

For slight additional effort.

Acrobat accuracy depends on your output device. Quick and convenient on screen. And very easy to magnify. Pleasant and highly readable on any laser printer. Or camera-ready on a phototypesetter.

NEED HELP?

Phone or write all your US Tech Musings questions to:

Don Lancaster
Synergetics
Box 809-EN
Thatcher, AZ, 85552
(520) 428-4073

US email: *don@tinaja.com*
Web page: *www.tinaja.com*

REPRINT RESOURCES

Dialog Information Service
3460 Hillview Avenue
Palo Alto CA 94304
(415) 858-2700

GEnie
401 North Washington Street
Rockville MD 20850
(800) 638-9636

Global Engineering Documents
15 Inverness Way East
Englewood CO 80112
(800) 854-7179

Information Store
500 Sansom Street #400
San Francisco CA 94111
(415) 433-5500

UMI
300 North Zeeb Road
Ann Arbor MI 48106
(800) 521-3044

US Government Bookstore
720 North Main Street
Pueblo CO 81003
(719) 544-3142

Acrobat documents can easily be edited or modified. Raw words-only unformatted text could get extracted by cut-and-paste by using tools in the Acrobat reader. But infinitely better is a fully formatted text and graphics editing or rearrangement that you can do by using *Adobe Illustrator*.

Two gotchas here: Be sure to use Illustrator v5.5 or higher. And make sure that your *Acrobat PDF plug-in* is host installed.

Many pagemaking programs are fast becoming Acrobat literate.

Yes, all of my earlier ".GPS" *guru gonzo* tech illustrations can also now work fine with Illustrator. Simply by routing them on through the Acrobat distiller module first.

Getting Documents

What if you just gotta have your own personal hard copy of some tech article or standard? Where do you go for fast help?

First and foremost, go online and snoop around. Tens of thousands of sources are now scrambling to offer millions of Acrobat format reprints to you. Many free for the downloading. Through the internet, the commercial online services, and even by way of local BBS systems.

I have posted a few key document retrieval supply sources for this month's resource sidebar.

Your all time classic standby, of course, was interlibrary loan. Sadly, many libraries have recently dropped this service. Or have made it slow, expensive, or incompetent.

With fewer participants, your odds of a useful hit are far lower. Today, interlibrary loan is almost certain to

be a frustrating waste of time.

Another traditional source is *UMI*, short for *University Microfilms*. Who sell copies of any magazine or tech article from nearly anywhere. But to use them, you will have to specify those *exact* journal, volume, author, and page numbers. The cost varies with their speed of service.

UMI has recently added a sorely needed new service by opening *The Information Store*. Which is a handy place to find all the *really* hard-to-get stuff such as conference proceedings, obscure reprints, or standards.

A list of standards organizations appeared back in HACK47.PDF. Most of these are now stocked in depth by *Global Engineering Documents*.

These folks are rather pricey, but they do have what you want the very instant you need it.

It is usually cheaper and slower to go directly to the standards group.

By far the best place to find out if a paper or document exists is through the *Dialog Information Service*. By way of your local library, *GEnie*, or one of those other commercial online services. Dialog is great for searches and abstracts. But other services may be better for actual hard copy.

The feds seem a sometimes useful source for lettuce leaflets and such. They've gotten remarkably easier to deal with from 24 "retail" outlets.

Going by the catchy name of *U.S. Government Bookstore*. I've shown only one in the sidebar. Contact them for a list of all the others.

Individual reprints of most of my own columns are instantly available on *www.tinaja.com* As BOD bound hard copy from *Synergetics*.

We can also find *any* document for you on a custom basis.

BASIC Stamp Manuals

We looked at the $29 *BASIC Stamp* two columns back. This is *the* hacker microcomputer. We have had great heaping bunches of helpline requests for more info on this. So, I've started a *Pic a Peck of PICs* resource page on my *www.tinaja.com*

You can get free Basic Stamp ap notes and manuals directly through Lance Walley at *Parallax*. Just use the site links I have provided.

New Tech Lit

From *Plessey* a new *Consumer IC Handbook* full of remote control and satellite chips. Plessey has also just released the GP1010 *single chip* GPS receiver front end. Plus a companion application breadboard and a GP1020 back-end six channel correlator.

National Semiconductor has free samples of their new LM45 *Precision Centigrade IC Temperature Sensor*. From *Hewlett Packard*, free samples of IrDA infrared comm parts.

Plenty of remote infrared sensing info appears in that free *Handbook of Non-Contact Temperature Sensing* from *Exergen*.

Two unusual trade journals useful for exploring new desktop concepts: *Inside Finishing* on foil stamping and Kroy Color materials. Plus *P-O-P & Sign Design* on newer plastics and unusual prototyping materials.

Both are highly valuable. P-O-P

NAMES AND NUMBERS

Adobe Acrobat System
1585 Charleston Road
Mountain View CA 94039
(800) 833-6687

American Gourd Society
PO Box 274
Mount Gilead OH 43338
(419) 362-6446

Embossing Arts
PO Box 626
Sweet Home OR 97386
(503) 367-3279

Exergen
One Bridge Stret
Newton MA 02158
(800) 422-3006

Inside Finishing
PO Box 56652
Washington DC 20040
(202) 882-7949

Lindsay Publications
PO Box 538
Bradley IL 60915
(815) 935-5353

National Semiconductor
2900 Semiconductor Road
Santa Clara CA 95052
(800) 272-9959

Parallax
3805 Atherton Road, #102
Rocklin CA 95765
(916) 624-8333

Plessey
PO Box 660017
Scotts Valley CA 95067
(800) 927-2772

P-O-P & Sign Design
7400 Skokie Blvd
Skokie IL 60077
(708) 675-7400

Scientific American
415 Madison Avenue
New York NY 10017
(212) 754-0550

SIAM
3600 University Science Center
Philadelphia PA 19104
(215) 382-9800

Springer-Verlag
175 Fifth Ave
New York NY 10010
(212) 460-1500

Synergetics
Box 809
Thatcher AZ 85552
(602) 428-4073

---

stands for *point of purchase*.

Also get yourself a free copy of the *Embossing Arts* catalog. Bunches of desktop opportunities here.

When you are about to go off your gourd, there's a support group called the *American Gourd Society* that can help you. They have a free catalog of useful books and bulletins.

To really immerse yourself into the desktop publishing scene, check out my *Book-on-demand Resource Kit*.

Which has everything you'll need to get yourself started.

Our usual reminder to check the *Names & Numbers* or that *Reprint Resources* sidebars for references on most everything I've mentioned. ❖