

Every time that I mention his name in print, I get bunches of static from card carrying members of the Cult of the Latter Day Teslaites.

Along with hundreds of pages of dreary and poorly thought out "looks like a duck and quacks like a duck" incoherent pseudoscience drivel.

Based on my extensive study and review, here's how I see things:

Yes, Tesla was one of the superbly brilliant engineers of all time. Tesla's developments of the induction motor, polyphase ac machinery, and the ac transformer do remain crucial keys to nearly everything electrical.

Yes, Tesla was treated unfairly by history. Grossly so. Caused mostly by being at war with Tesla's native country and the blatant propaganda of Edison's humongous PR mill.

No, Tesla was not original in his explorations of fluorescent lighting or radio. He was one of many sources working on these topics.

As with any product developer, the way you get a few brilliant ideas is to start off with bunches of lousy ones. Eventually something will stick to the ceiling. For every good idea, there are zillions of bad ones.

There is not one scrap of credible evidence that shows Tesla had any "free" *earth resonance* energy. This was just an uncompleted experiment that was virtually certain of failure.

There was apparently some major confusion between resonant energy buildup and a true energy sourcing. Caused in part by Tesla being one brilliant experimenter but a terrible theoretician. You'll also find strong evidence of earth resonance being a lab funding scam.

A piggy bank may have hundreds of dollars in it, but they got there a nickel and a dime at a time. It's the same with resonance. You can build up lots and lots of resonant energy a little bit at a time. And you could remove that energy very quickly. But you'll *never* get back any more than was put in. You most certainly can *not* sustain continuous removal.

Such an energy system would be a blatant violation of the second law of thermodynamics. We saw lots on this in the *Hardware Hacker* reprints and in HACK64.PDF. So far, *all* attempts at second law violation have failed.

Without exception.

If you feel that earth resonant free energy is possible, fine. But note that the only way you'll convince anyone else of it is to come up with a simple and easily duplicated experiment that generates *one net watt* of power. Or publish a peer reviewed analysis of a credible theory that supports such an unlikely energy source.

Also note that your probability of

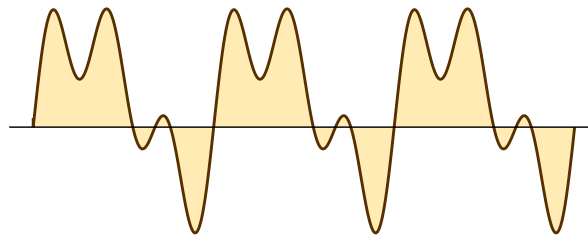
success is zero. These days, there's great heaping bunches of legitimate emerging electronic opportunities.

By all means, do study Tesla and learn from him. But concentrate your readings on all of the actual historical documents and not on any latter day pseudoscience ramblings. One good source for Tesla research is *Lindsay Publications*. A second is the *Tesla Bookstore* service.

We saw a list of Tesla resources back in HACK45.PDF. More on Tesla cultism and engineering ratholes in my BLATRAT.PDF.

On to a second colorful historical character of major import...

This is an example of a repetitive waveform...



Classic Fourier Series tells us that this waveform consists of...

- A dc level, offset, unbalance, or level shift
– PLUS –
- A fundamental sine wave of some amplitude
– PLUS –
- A fundamental cosine wave of some amplitude
– PLUS –
- A second harmonic sine wave of some amplitude
– PLUS –
- A second harmonic cosine wave of some amplitude
– PLUS –
- A third harmonic sine wave of a specified amplitude
– PLUS –
- A third harmonic cosine wave of some amplitude
– PLUS –
- As many extra sine and cosines of higher harmonics as are required for accuracy.

Fig. 1 – THE CLASSIC FOURIER SERIES is an essential tool. Both for waveform analysis and Fast Fourier Transforms or Wavelet work.

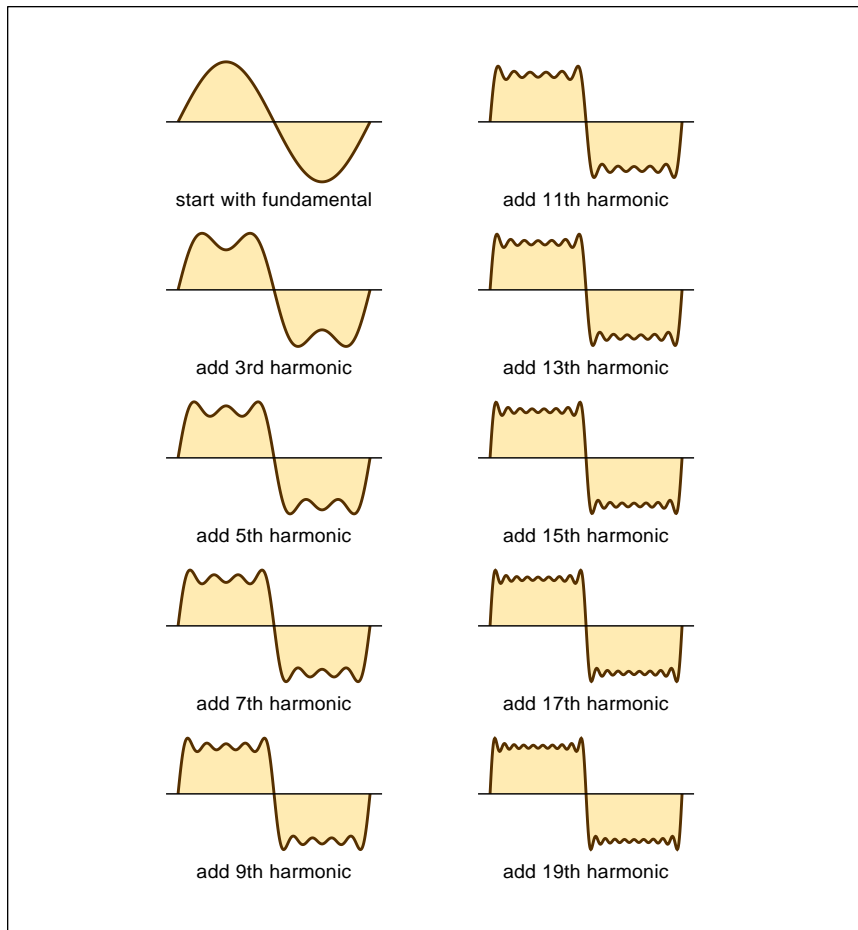


Fig. 2 – BUILDING UP A SQUARE WAVE one harmonic at a time.

Fourier and His Series

There's lots of times and places in physics and electronics where you'll want to relate time and frequency. For instance, you might listen to a song or view its music on a printed page. One gives you the actual audio tones; the other shows you how the tones are arranged in time.

Relating time and frequency is of crucial importance in side looking radar, spectrum analysis, holography, seismography, geophysics, vibration studies, cardiology, in cryptography, data compression, correlation, feature extraction, and picture deblurring.

Jean Baptiste Joseph Fourier (1768-1830) was one cool dude. Strange but cool. I urge you to look up his bio in the *Britannica Great Books* #45 or wherever. While famous for a theory of heat, his primary contribution to electronics consisted of a math tool that relates time and frequency.

Called, of all things, the *Classic*

Fourier Series. Classic Fourier Series applies to repetitive waveforms. This extends to continuous signals as the *Fourier Transform*. A newer variant is the *Fast Fourier Transform*, which dramatically speeds up most digital processing of sampled data.

One exciting newer replacement tool is called *Wavelet Theory*. Which completely blows away Fourier "one size fits all" hassles.

Classic Fourier series is the secret to understanding any and all of the newer stuff. Besides being way more intuitive. While still remaining very useful in its own light.

Figure one shows us the concept involved. Say you have a repetitive waveform you wish to analyze.

Fourier tells us we can represent any waveform as a dc term plus sine and cosine waves of a fundamental frequency. Plus sines and cosines of even and odd harmonics.

For instance, a square wave is equal to a fundamental plus one-third of the

third harmonic, one-fifth of your fifth harmonic and so on. A square wave also has even harmonics, but these all end up at zero amplitude. Figure two shows the "progressive build" quality of Fourier Series when we add lots of harmonics to make a waveform.

Observe that any waveform and its classic Fourier series end up *identical* and *interchangeable*. Thus, you can generate a square wave all at once, or build it up harmonic by harmonic. You can analyze a square wave all at once, or by individual harmonics.

Also known as *superposition*.

More often than not, only a few key harmonics are of great interest. For instance, a vibration study on a moving piece of machinery might show strong Fourier components at specific frequencies that can instantly pinpoint possible problems.

Each Fourier component can get treated individually. Because of one remarkable trig property.

A *cosine* wave is just a *sinewave* whose phase is shifted by 90 degrees. Or precisely *one-quarter* of the full cycle. These sine and cosine waves are *quadrature* or *orthogonal*.

Here is the neat part: Sines and cosines are largely "invisible" to each other and *fully independent*. And any single frequency waveform can be created simply by summing its sine and cosine components. Check any trig book for full details.

Why are sines and cosines largely invisible to each other? *Because their cross-product over any cycle is zero!* You can prove this to yourself by sketching out a sine and cosine over a full cycle. Their product is positive in quadrants one and four. But it is negative in quadrants two and three.

Exactly cancelling.

Even more important, *all the cross products between harmonics are also zero!* Thus, a full cycle product of a third harmonic sine and some sixth harmonic cosine will *always* be zero. Same for a second harmonic sine and a thirty-seventh harmonic sine. Or cosine against cosine. This "all cross products cancel to zero" ploy is *why* Fourier Series works. All those sines and cosines end up fully independent; they do not interact.

To analyze your classic Fourier Series, you first find your *offset* or *dc term*. This is simply how much more

is on top than on the bottom of one full cycle. Many waveforms have a zero dc term. Especially if they are capacitively coupled in some audio circuit. On the other hand, that dc term is precisely what you are after in a half-wave or full-wave rectifier. The rectifier harmonics are usually undesirable "hum" to get ruthlessly stomped upon.

Next, you'll try different sizes of fundamental sinewaves, finding out which one removes the most energy from your waveform. Then you try different sizes of fundamental cosine waves, once again removing as much remaining energy as you can. Your fundamental amplitude can be shown as sine and cosine values, or can be combined into one magnitude having that usual square-root-of-the-sum-of-the-squares relation.

Next, you step on up to the second harmonic. Letting its sine and cosine terms take out as much remaining energy as possible. Continue this for all harmonics of interest.

Waveforms that have an identical positive and negative cycle should guarantee a zero dc term. Waveforms with *halfwave symmetry* guarantee no even harmonics. Waveforms which possess *mirror symmetry* on their half cycles should guarantee zero cosine terms. Other tricks can be played to simplify analysis or to force certain harmonic patterns.

Figure three shows us the Fourier Series for a few common waveforms. Note how a full wave rectifier has no fundamental term. One curious and unusual result: This waveform thus has *infinite* distortion!

Back in the Apple days, I had my students searching for long binary sequences which had powerful third, fourth, and fifth harmonics but little else. Letting you play *chords*.

One place where I'd like to do some more Fourier work is the "hum on the desert" phenomena.

I can assure you that this effect is very much real. Often sounding as a just barely audible "generator". In places where there are no generators for dozens of miles.

This one is highly intermittent and maddeningly infuriating.

I suspect this effect has multiple and mundane causes. Such as distant trains or scads of flying bugs. I also

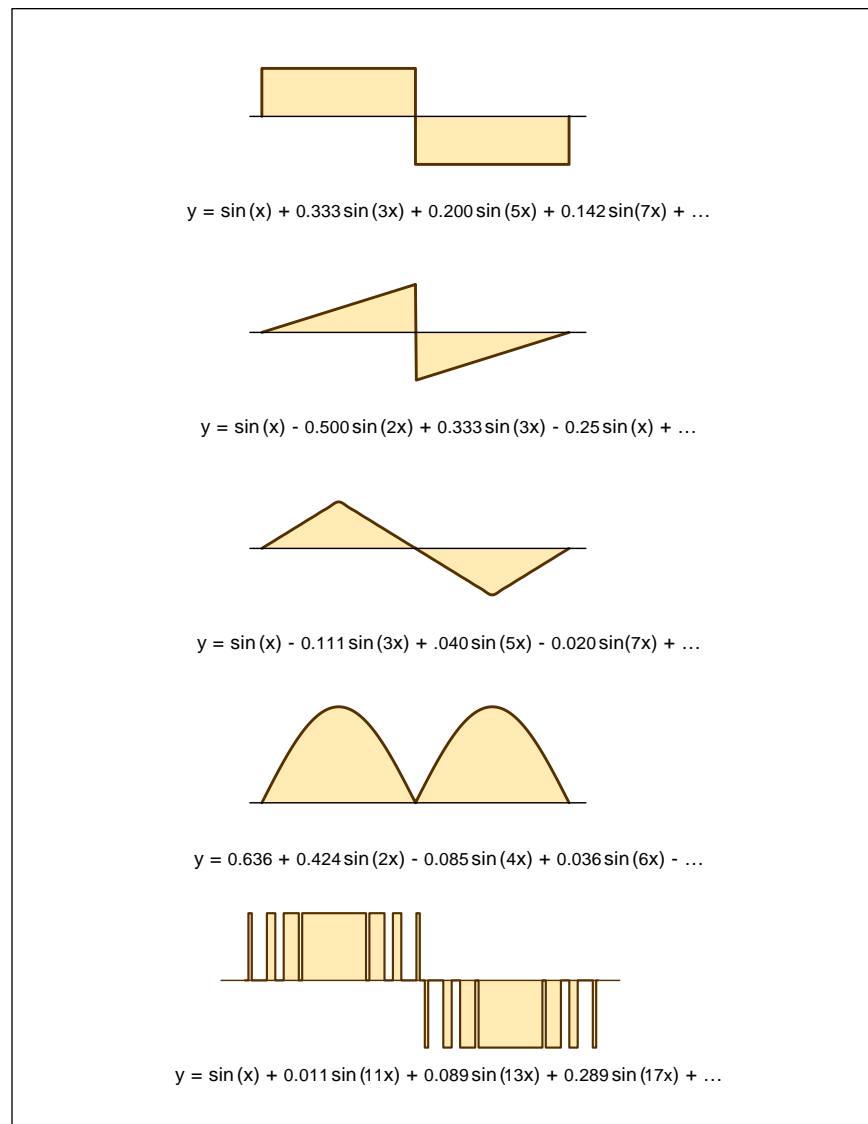


Fig. 3 – FOURIER SERIES EQUIVALENTS for some useful waveforms.

suspect that the acoustic resonance of a van greatly magnifies it.

One free *Incredible Secret Money Machine II* if you are able to send me any hard data on this. Surely there is a scientific explanation.

Most any old college level circuit theory book covers Fourier Series. My favorite here is Skilling's ancient *Electrical Engineering Circuits*. In his chapters 14 and 15.

I have put together a simple and powerful interactive Fourier Series analyzer. It is written in PostScript, of course. Waveforms can be either mathematically defined or else come from a list of sampled numbers.

The code is somewhat long to list here, besides being tedious to hand

key. I've posted it as FOURIER.PS to my *GENIE* PSRT RoundTable. It is available for the downloading.

You'll find more on transforms in HACK42.PDF. Wavelet shareware is in WAVELET.PAK. And the wavelet books are in HACK86.PDF.

If you do not yet have PostScript available, we've also newly uploaded the latest versions of the *GhostScript* shareware offerings.

As files #1162-1169.

For a detailed application tutorial, also check out MAGSINE.PDF. This one greatly expands upon the magic sinewave stuff we have looked at in past columns. And is a "must have" if you are at all into electric cars or ac induction motor controls.

CLASSIC COMPUTER RESOURCES

The Calculator Collector
Intl Assn Calculator Collectors
10445 Victoria Ave
Riverside, CA 92503

Collector's Guide to PC's
PO Box 2326
Florence AL 35630
(205) 757-9966

The Computer Journal
PO Box 535
Lincoln CA 95648
(916) 645-1670

Computer Museum
Museum Wharf
Boston MA 02210
(617) 426-2800

Corvatek (Franklin)
561 NW Van Buren Street
Corvallis OR 97330
(503) 752-4833

Dynacomp (Atari)
178 Phillips Road
Webster NY 14580
(800) 828-6772

Forth Interest Group
PO Box 2154
Oakland CA 94621
(510) 89-FORTH

GIMIX/OS-9 (6800/6809)
3223 Arnold Lane
Northbrook IL 60062
(800) 559-0909

Historically Brewed
Historical Computer Society
2962 Park Street #1
Jacksonville FL 32205

Herb Johnson (S-100)
CN 5256 #105
Princeton NJ 08543
(609) 771-1503

Microcomputer Library
4209 France Avenue N
Robbinsdale MN 55422
(612) 533-3226

NOVAOUG (Osborne)
7512 Fairwood Land
Falls Church VA 22046
(703) 534-1186

Oughtred Society
8338 Colombar Ct
San Jose CA 95135
(408) 238-8082

Parts is Parts (Zenith)
137 Barkley Avenue
Clifton NJ 07011
(201) 340-7333

Pre-Owned Electronics
30 Clematis Avenue
Waltham MA 02154
(800) 274-5343

Jay Sabe (Z-Systems)
1435 Centre Street
Newton Centre MA 02159
(617) 965-7259

Shreve Systems
3804 Karen Dr
Bossier City LA 71112
(800) 227-3971

Charles Stafford (Kaypro)
4000 Norris Avenue
Sacramento CA 95821
(916) 483-0312

Stanch 8/89er (Heath)
PO Box 548
West Branch IA 52358
(319) 643-7136

Sydex (CP/M)
PO Box 5700
Eugene OR 97405
(503) 683-6033

that a supporting computer gets to be extremely handy.

Snap-in hard drives can optionally substitute for videotape cartridges. The bare system costs \$2990. Less the drives, nonlinear, and display.

I've yet to test this gem and put it through its paces, but this one is a product that cannot miss. My original loaner toaster is now at *Black Range Films*, still doing yeoman duty for everything from videos on straw bale home construction to cable tv pilots to kivas to UFO grand tours.

Do stay tuned right here for more details as they unfold.

NewTek has a free video available. *Video Toaster User* magazine offers outstanding tutorials and help. More info on the original toaster appeared on back in HACK60.PDF.

A \$290 GPS Receiver

Terry Maurel loaned me his new *Garmin* GPS-45 receiver on a recent cave trip. I only had a few minutes to play around with it. This is both (A) utterly amazing, and (B) not quite good enough for me.

Street price is a mere \$290 for a unit the shape of a small handheld scanner. A short stub antenna is built in. The features provided are nothing short of incredible.

This system rapidly tells you your exact location anywhere in the world. Latitude, longitude, and elevation. After the normal warmup, it updates itself every second. Outdoors only, of course. With clear sky overhead.

A built in multimode liquid crystal display reveals everything from the pattern of satellites and their signal strengths to your current travel path and waypoints. Your speed is limited to 100 miles per hour.

The stand-alone accuracy typically

NewTek's Toaster for Windows

For those of you that came in late, Commodore just got sold at a yard sale for \$12.95. Well, for twelve mil, actually. In a bizarre transaction that appears to have thrown out the baby and drunken the washwater.

Which leaves the *Amiga* as a less than stellar platform to develop any expanding product base upon.

So, *NewTek* has just announced a stunning new addition to their *Video Toaster* product line. A *portable* and optionally *stand alone* small box that fully supports *nonlinear editing*. And interfaces with *any* computer having a SCSI port. Those running *Windows* fer openers. Mac later.

Even more mind-blowing, you can *eliminate all videotape completely!* Just connect your mid- to high- range home camcorder *directly* in to your toaster. Store the images *directly* to hard disk. Typical camcorder image sensors offer outstanding quality; it is only when your image hits the tape that it dramatically degrades.

No more generation loss!

You'll also need one less monitor and one less TBC time base corrector, since these insert into the basic box. Their toaster can do routine editing tasks all by itself. Without needing *any* computer connection at all.

It is only when you decide to do serious animation rendering, fancy transitions, or other "gee whiz" stuff

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

NAMES AND NUMBERS

Closeout News

728 East 8th Street #1
Holland MI 49423
(616) 392-9687

Garmin

9875 Widmer Road
Oenexa KS 66215
(800) 800-1020

GENie

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

GPS World

859 Willamette St
Eugene OR 97440
(503) 343-1200

Steve Hansen's Bell Jar

35 Windsor Dr
Amherst NH 03031
(603) 429-0948

Institute of Navigation

1800 Diagonal Road #480
Alexandria VA 22314
(703) 683-7101

Lindsay Publications

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

LPKF Distribution

6840 SW Canyon Drive
Portland OR 97225
(800) 345-LPKF

Switchable Privacy Glass

Marvin Windows
Warroad MN 56763
(800) 346-5128

Navtech Books & Software

2775 S Quincy Street #610
Arlington VA 22206
(800) NAV-0885

NetGuide

600 Community Drive
Manhasset NY 11030
(516) 562-5000

NewTek

1200 SW Executive Drive
Topeka KS 66615
(800) 847-6111

Response TV

201 E Sandpointe Avenue #600
Santa Ana CA 92707
(800) 854-3112

Science/AAAS

1333 H Street NW
Washington DC 20005
(202) 326-6400

Tesla Book Co

Box 121873
Chula Vista CA 91912
(805) 646-3371

Video Toaster User

273 North Matilda Avenue
Sunnyvale CA 94086
(408) 252-0508

VR World

20 Ketchum Street
Westport CT 06880
(203) 226-6967

West Marine

PO Box 50050
Watsonville CA 95077
(800) 538-0775

averages plus or minus 300 feet or so. But may occasionally get gruesomely worse. Possibly for hours at a time. The military also has the option of purposely fouling up the signals.

You can dramatically improve the accuracy by using *differential mode* from a second receiver or a FM radio correction service.

Differential GPS works by having a second receiver at a known site.

The difference between where it really is and where GPS thinks it is becomes the correction values for the moving GPS receiver.

Uh, there is this failed and long forgotten lumber tramway which is literally in my front yard. One that includes an astounding drop of well over *one vertical mile*. Besides being partially gravity powered. I've been doing some historical archaeology on this and sure could use a GPS system

with better than thirty foot accuracy. More details on this fascinating beast in GRAMTRAM.PDF.

One distributor for Garmin is *West Marine*. Lots more on GPS in general from *GPS World* magazine, from the *Navtech Bookstore*, and the *Institute of Navigation*.

A review of the Garmin 45 appears as GARMIN45.TXT. Or HACK48.PDF for more GPS background.

Classic Computer Resources

These days, all of the classic early computers are *not* a bargain in any way, shape, or form. You certainly should *not* buy one just because it seems cheap at some hamfest or swap meet. Especially not as a "favor" to a child or a handicapped person.

On the other hand, you might like to collect and restore an early classic computer. Or are trying to keep your

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LOTS OF OTHER GOODIES

Ask the Guru I or II or III \$24.50
Hardware Hacker II, III or IV \$24.50
Micro Cookbook I \$19.50
PostScript Beginner Stuff \$29.50
PostScript Show and Tell \$29.50
Intro to PostScript Video \$29.50
PostScript Reference II \$34.50
PostScript Tutorial/Cookbook \$22.50
PostScript by Example \$32.50
Understanding PS Programming \$29.50
PostScript: A Visual Approach \$22.50
PostScript Program Design \$24.50
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LaserWriter Reference \$19.50
Type 1 Font Format \$16.50
Acrobat Reference \$24.50
Whole works (all PostScript) \$380.00
Synergetics Surplus Catalog **FREE**
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VISA/MC

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Box 809-NV
Thatcher, AZ 85552
(520) 428-4073

existing one alive in some marginal use which does not justify anything newer. Or just happen to like some earlier machine that does a specific task *exactly* the way you want it to. This column, of course, is still being written on an Apple IIe.

Nearly all of those special interest magazines and user groups have long folded. Most of the experts have gone on to greener pastures. And simply cannot afford supporting stuff which can not pay for their time.

This month's resource sidebar lists several remaining places to try for parts and info on classic computers.

Foremost here is *The Computer Journal*. Still at their same old stall after all these years. They regularly publish resource directories.

An excellent price directory is the recent *Collectors Guide to Personal Computers*. *Historically Brewed* is a good newsletter.

There's also lots of superb online support. Ferinstance, GENie's A2 and A2.PRO RoundTables still provide the finest in any remaining classic Apple support. And there's bound to be all sorts of Internet nooks and crannies offering specialized help.

Please let me know anything major I missed on this listing.

New Tech Lit

More papers on DNA computing, including new designs that far exceed human brain capacity appear in the April 28, 1995 issue of *Science*. Their new *Computation Beyond the Turing*

Limit story is no slouch, either.

An alternate to plate-thru circuit boards is offered by *LPKF*. This is a conductive epoxy that extrudes thru each hole. After a partial cure, the central hole is blown out, leaving a conductive plastic eyelet. Around ten cents per hole.

They also provide snap-off copper tubes in their *Copperset* system.

Large area liquid crystal panels are now sold for architectural purposes by *Marvin Windows and Doors*. The *Switchable Privacy Glass* costs \$90 per square foot. Maximum size is 35 x 84 inches. The response switching time is likely to be way too slow for VR virtual reality uses.

Speaking of which, *VR World* is a glossy magazine about virtual reality. *NetGuide* is but one of the many new Internet magazines.

Response TV is the primary trade journal of that infomercial industry. *Closeout News* does have surplus and distress merchandize in it. Including phones and electronics.

One good Internet source for car ignition computer information is: MajorDomo@columb.eng.ohio-state.edu

An Experimenter's Introduction to Vacuum Technology is the new Steve Hansen booklet. Mostly reprints from his great *Bell Jar* vacuum news.

I've just received fresh stock on the *seventeenth* classic reprinting of my *Active Filter Cookbook*. This is by far *the* bestselling book on active filters of all time. Check my nearby *Synergetics* ad for availability. ♦