Don Lancaster's

RESOURCE BIN

number ninety

A look at GPS and other nav resources.

Our usual reminder here that the *Resource Bin* is now a two-way column. You can get tech help, consultant referrals and off-the-wall networking on nearly any electronic, *tinaja questing*, personal publishing, money machine, or computer topic by calling me at (520) 428-4073 weekdays 8-5 Mountain Standard Time.

Be certain to frequently check out my new *Guru's Lair* web site you'll find at (where else?) *www.tinaja.com* This is the place you'll go for instant tech answers. Among the many files in our library, you will find complete reprint sets for all of the *Resource Bin* and other columns. Plus a brand new Research InfoPack Service.

You will get the best results if you have both *Netscape Communicator* and *Acrobat Reader 3.0* installed.

A Look at GPS

GPS is short for *Global Positioning Satellites*, a collection of 24 wandering satellites which give you navigation, altitude, time, and speed info.

Anywhere in the world. To eighty foot accuracy with simple and cheap techniques. Fancier schemes let you hit aircraft landing precision and even sub-centimeter surveyor accuracy.

GPS is assigned two low microwave frequencies. Their L1 carrier is set at 1575.42 MHz and includes a complex pseudorandom coding for timing and status messages. Their L2 carrier is at 1227.60 MHz and can be selectively used to add precision.

GPS makes use of *spread spectrum* communications. In which *all* of the satellites are on the same frequencies at the same time. The signal from each satellite is seperately identified by its *pseudorandom spreading code*.

Signal strength is often well below noise, so elaborate reception circuits and software are required.

Because of all that fancy receiver circuitry and highly elaborate signal processing needed, building up your own GPS receiver from scratch does not make much sense. Instead, you'll adapt commercial or surplus devices.

Or, if you must, start with pretested chip sets from *Rockwell*, *Mitel*, *Plessey*, *Motorola*, *SGS*, or others.

GPS uses *triangulation*. In which the relative time differences from several satellites are compared. A minimum of four satellites is usually required. Because three might give you one of two possible answers in 3D space. But in general, the more birds processed the better. Parallel processing of eight receiver channels often gets done for reliability and accuracy.

Note that GPS only works outside. And then only when the major part of the sky is clearly visible. Dense forests or deep canyons (urban or otherwise) are a no-no. City vehicle nav demands GPS be backed up with gyros, dead reconing, wireless, or whatever.

GPS receivers for internal cave use are best combined with a wrist worn sundial and the new *lost wax* mapping technique. Ask any caver.

Highly accurate GPS takes special refinements. Although simply waiting hours for a long term average helps a bunch. Methods of gaining accuracy could include using as many channels as possible; also receiving the Russkie *Glonass* satellites; and using both GPS frequencies together.

NEXT MONTH: Don looks into places to go for antenna info.

But your real biggie here is to use *differential GPS* Where you park one receiver on a known benchmark and then measure any *differences* between where it thinks it is compared to its known position. Such corrections are useful over a large area. As much as twenty miles or more. Corrections are best applied in real time, but simply noting the drift and modifying your results later helps bunches.

Differential corrections are offered as subscriber subcarriers on a number of commercial FM stations. The US Coast Guard also transmits the DGPS data corrections, as do a number of fee based or free services.

An even fancier technique beyond differential is called *Carrier Phase GPS*. The higher carrier frequency leads to quite precise timing when properly applied in advanced circuitry.

Yet another refinement is known as *ephermeris error correction* It also can lead to improved results.

GPS antennas are suprisingly small, since they cover the full sky. Custom antenna design and matching is way beyond most home labs.

One current GPS nasty is known as *selective availability*. Sadly, the military is still in control of GPS and reserves the right to purposely and suddenly reduce system accuracy any time they feel like it. Fortunately, a differential correction eliminates this error.

I've used GPS on wilderness hikes a lot, especially in the Galuiros and in other obscure corners of Basin and Range. GPS also has proven handy in trying to correlate distant previously mapped cave passages against surface sinks and related features.

But the real biggie for me has been on the *Mount Graham Aerial Tramway*. Which was one utterly amazing piece of engineering that delivered sawn timber over seven miles horizontally and *well over one mile vertically*.

As the covered terrain would make a marine seargant blanch, GPS proved most useful in retracing the original route. Especially in dense brush. More on all this can be downloaded from *www.tinaja.com/glib/gramtram.pdf*.

Here is a rundown of some useful GPS resources...

GPS World

The leading trade journal here is *GPS World*. Here you'll find ads for all the major players. Both on the system and chip level. Along with ap notes and worldwide use examples.

They also do publish an occasional shoper that is called the *GPS Product Showcase*. This one usually also runs the results of their annual GPS user contests as well.

Always start here.

Institute of Navigation

These folks are nav experts. They put on an annual ION GPS conference.

They publish a scholarly quarterly *Navigation* journal, offer monographs of the definitive GPS "red books", and run lots of regional tech meetings.

Their website is *www.ion.org*

The full five volume GPS standards sell for $120. Volumes are by date of published papers, with Vol I going up to 1980 and Vol. V being current. They have a *Recommended Test Procedures for GPS Receivers* standard at $50.

Navtech Bookstore

One very useful source for tech info on GPS is the *Navtech Bookstore*. The primary Navtech designs vehicle map information systems and turn-by-turn route guidance services. Navtech is at *www.navtech.com*, while the bookstore stuff is at *www.navtechgps.com* Besides their publications, they are also into GPS technical seminars, data logging software, and resale of most popular mainstream GPS products.

Navtech Books stocks the insider goodies not found at *Amazon* and the other broad coverage tech bookstores. In particular, they resell the *Navstar Interface Control Document*, the *Glonass Interface Control Document*, and those *Navstar GPS User Equipment* reprints.

Speaking of GPS books, I've placed a recommended listing of them up to *www.tinaja.com/amlink01.html*. Here's a few more popular titles...

Aviators guide to GPS
GPS for Everyone
GPS for Geodesy
GPS for Land Surveyors
GPS Instant Navgation
GPS Land Navigation
GPS Made Easy
GPS Satellite Surveying
Simple GPS Navigation
Understanding GPS
Using GPS
Wilderness Navigation

Trimble

One of your major GPS players is *Trimble Navigation*. Who specialize in lower power portable solutions for avionics, land survey, GIS systems, marine, military, mining, mobile, ag, and software services. They offer a lot of support and training options as well. Courses now cover land survey, mapping and GIS. GIS is an acronym for *geographical information systems*.

Trimble has a useful GPS tutorial up at *www.trimble.com/gps*

A few other GPS receiver suppliers might include...

Allen Osborne
Allied Signal
Axiom
Ashtech
Carl Zeiss
Datum
Furuno
Garmin
Leica
Lowrance
Magellan
Magnavox
Motorola
Nikon
Novatel
Omnistar
Racal
Rockwell
Trimble
TrueTime
Universal Avionics

...among many others. As we've already seen, *GPS World* magazine is a good place to pick up details on the latest offerings. Other suppliers can be found with *GeoWeb Interactive* at *ggrweb.com/gps_rec.html*

Starlink GPS

Starlink Incorporated is one leading supplier of differental GPS solutions. They offer several *Navstar* systems which give extreme accuracy. Found at *www.starlinkdgps.com*

This site has many links to all of the major GPS players worldwide. It is a very web useful gateway to anything and everything GPS related. They also include a worldwide listing of the differential correction services.

Newsgroups & Newsletters

Your two leading newsgroups can be found up at *sci.geo.satellite-nav* and *sci.engr.surveying* There is also a GPS Technology mailing list. You join via *gpstech-request@cotopaxi.stanford.edu* or post via *gpstech@cotopaxi.stanford.edu*

SOME USEFUL GPS RESOURCES

Allen Osborne
756 Lakefield Rd
Westlake Village CA 91361
(805) 495-8420
www.aoa-gps.com

AlliedSignal
101 Columbia Rd
Morristown NJ 07862
(973) 455-2000
www.alliedsignal.com

Ashtech
1170 Kifer Rd
Sunnyvale CA 94086
(408) 524-1400
www.magellangps.com

Axiom Manufacturing
717 Lingco Drive #202
Richardson TX 75081
(214) 994-9676
www.axiomnav.com

Carl Zeiss
Thornwood NY
www.zeiss.com/survey/gps

Datum Inc
9975 Toledo Way
Irvine CA 92618
(949) 598-7500
www.datum.com

EOM
13741 E Rice Place Ste 200
Aurora CO 80015
(303) 690-2242

Furuno
4400 NW Pacific Rim Blvd
Camas WA 98607
(360) 834-9300
www.furuno.com

Garmin
9875 Widmer Rd
Oenexa KS 66215
(800) 800-1020
www.garmin.com

GeoWeb Interactive
ggrweb.com/gps_rec.html

GIS World
Ft Collins CO
(970) 221-0037

GPS Product Showcase
859 Willamette St
Eugene OR 97440
(503) 343-1200
www.gpsworld.com

GPS World
859 Willamette St
Eugene OR 97440
(503) 343-1200
www.gpsworld.com

Institute of Navigation
1800 Diagonal Rd #480
Alexandria VA 22314
(703) 683-7101
www.ion.org

ITS World
859 Willamett St
Eugene OR 97401
(541)343-1200
www.gpsworld.com

Leica GPS
23868 Hawthorne Blvd
Torrance CA 90505
(310) 791-5300
www.leica.com

Lowrance
GPS Division
Tulsa OK 74128
(800) 324-1356
www.lowrance.com

Magellan Systems Corp
960 Overland Ct
San Dimas CA 91773
(818) 358-2362
www.magellangps.com

Magnavox
2829 Maricopa St
Torrance CA 90503
(800) 421-5864
www.philips.com

Map One
PO Box 999
Dewey AZ 86327
(520) 632-8774
www.mapone.com

Mitel
2321 Morena Blvd #M
San Diego CA 92110
(619) 276-3421
www.mitel.com

Motorola
5005 E McDowell Rd
Phoenix AZ 85008
(800) 521-6274
www.motorola.com

Motorola Comm Prods
1301 E Algonquin Road
Schaumburg IL 60196
(800) 668-6752
www.motorola.com

Navtech Books & Software
2775 S Quincy St #610
Arlington VA 22206
(800) NAV-0885
www.navtechgps.com

Nikon
1300 Walt Whitman Rd
Melville NY 11747
(800) 52-NIKON
www.nikonusa.com

NovAtel
PO Box 690268
Tulsa OK 74129
(918) 270-2383
www.novatel.com

OmniSTAR
8200 Westglen
Houston TX 77063
(713) 785-5850
www.omnistar.com

Racal Communications
5 Research Pl
Rockville MD 20850
(800) 258-4420
www.racalcomm.com

Rockwell Collins
350 Collins Rd NE
Cedar Rapids IA 52498
(800) 321-2223
www.cacd.rockwell.com

Rockwell International
3310 Miraloma Ave
Anaheim CA 98203
(800) 854-8099
www.rockwell.com

SGS-Thomson
1000 E Bell Rd
Phoenix AZ 85022
(602) 867-6259
www.st.com

Starlink
6400 Hwy 290 E Ste 202
Austin TX 78723
(800) 460-2167
www.starlinkdgps.com

Synergetics
Box 809
Thatcher AZ 85552
(520) 428-4073
www.tinaja.com

Trimble Navigation
585 N Mary Ave
Sunnyvale CA 94086
(800) 545-7762
www.trimble.com

TrueTime
2835 Duke Court
Santa Rosa CA 95407
www.truetime.com

Universal Avionics
3260 E Universal Way
Tucson AZ 85706
(800) 321-5253
www.uasc.com

Other Sites and Mags

While not GPS specific, that superb Microsoft *Terraserver* site is a major visit. You should find this site up at *terraserver.microsoft.com* This is a huge collection of aerial photos.

Mostly satellites and USGS.

USGS maps are finally available *free* online at *greenwood.cr.usgs.gov* Low cost CD ROM topo map collections are sold by *Map One* at *www.mapone.com*

Check them out.

EOM is short for *Earth Observation Magazine*. It targets geography, aerial photography, image processing, map resources, and earth info. The recent subjects included satellite remote sensing, disaster response data bases, and airborne GPS apps.

ITS World is a larger tabloid trade journal about *integrated transportation systems*. Mostly automated highways, nav solutions, and route guidance.

For More Help

Your usual web search engines at *www.hotbot.com* and *www.altavista.com* are obvious starting points. Find these osat *www.tinaja.com/webwb01.html*.

Lots more on doing web research in general at *www.tinaja.com/resbn01.html*

But those best two GPS places I've found are that previously mentioned *www.starlinkdgps.com* and the fine *GPS World* Solutions Data Base you'll find at *www.guru.gpsworld.com/gpsworld*

A well done group of GIS websites is at *www.hdm.com/gis3.htm* Also try *www.geoplace.com*. These folks publish a *GEO World* ezine.

A few GPS chips, data sheets, and ap notes are at *www.questlink.com*, but their coverage seems light.

Additional consulting and research services on GPS and related topics is available as my *Infopack* service up at *http/www.tinaja.com/info01.html*. or at *http://www.tinaja.com/consul01.html*.

Let's hear from you. ✦

