



SearchLites

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Our Quarterly Newsletter -- Our 25th Issue!

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E. T., Call Springer-Verlag!

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We humans have always wondered if we are alone, a preoccupation mirrored in our myths, from the Enuma Elish to Star Trek. The discovery of extraterrestrial life would be an earthshaking discovery, even more so than the Copernican revolution which shifted Earth from the center of the universe to its periphery. Scientists have long debated the parameters for such life, and the search has crystallized into the discipline of astrobiology.

Astrobiology theories fall between two positions. One is the mediocrity principle, which posits that we are not in any way special, and given the enormous numbers of galaxies, stars, etc., life -- including intelligent variants -- exists on many other planets. The other is the anthropic principle, which holds that the universe is optimal for human existence and hence we are the sole intelligent life form. The problem with both positions is that they base their statistics on a single sample. Additionally, the anthropic principle totally ignores the element of chance, which played a crucial role at all stages of biogenesis.

Two recent books from Springer-Verlag Publishing have joined the debate: *Here Be Dragons* by astronomer David Koerner and neuroscientist Simon LeVay, and *Rare Earth* by paleontologist Peter Ward and astronomer Donald Brownlee. The former has no ideological position, and its authors interviewed practically every scientist who contributed to astrobiology; the latter, by its title alone and by its introductory statement, unequivocally places itself into the anthropic principle camp.

Both books give overviews of the astrophysical, geological, chemical and biological events which resulted in the appearance, perseverance and evolution of life on Earth, with emphasis on the recent discoveries of extrasolar planets and extremophilic bacteria. *Rare Earth* is organized in the traditional trajectory of such books, tracing the terms of the much-(ab)used Drake equation. *Here Be Dragons* is organized less linearly and includes a chapter on UFOlogy. Both books range widely across disciplines and require considerable prior knowledge to read easily and evaluate critically; their style is even but colorless, and their rare flights of literary fancy barely achieve liftoff (for example, the toy sailboat/bacteria and ocean liner/eukarya analogy in *Rare Earth*).

In *Here Be Dragons* the style is dictated by the fact that the book is a collection of opinions, which show the fragmentary nature of the data, as well as the deep divisions of scientific opinion over the question of extraterrestrial life. In *Rare Earth*, the authors present the theories they favor as complete and widely accepted, masking the fact that many are controversial (for example, whether star metallicity is as rare as they describe and whether Cambrian Ediacarans represent additional extinct phyla). Furthermore, I spotted errors in my field of expertise (conflation of transcription and translation, a 20-fold exaggeration of the number of human genes -- both pertaining to the crucial concept of complexity) and a howler regarding the rotations of Mars and Venus (which are not locked, as the authors assert in their haste to make Earth unique in the solar system). These missteps make me wonder whether the authors misquoted additional facts instrumental to their hypothesis.

Which brings us to the crux of the matter, the hypothesis. The 'rare earth' theory is that though bacterial life may be common in the universe, intelligent life -- in the form of terrestrial animals and plants -- is unique. The prediction: upon examining other planets, we'll find that bacterial life is common, and intelligence absent -- a circular argument as, indeed, are all variants of the anthropic principle. In science, theories cannot be identical to their predictions, nor can their predictions be trivial. In fact, the rare earth theory is neither hypothesis nor prediction, but a description of how life arose on Earth.

Calculating probabilities after the fact is equivalent to placing a bet after the race has been run. Conversations about the rarity of intelligent extraterrestrial life rest upon an enormous assumption which Ward and Brownlee, to their credit, mention once per chapter -- that life elsewhere will be life as we know it. Their oft-repeated statement that both Earth and humans are unique is neither novel nor contested -- nor helpful in predicting life elsewhere. Given our current almost total lack of knowledge, such books serve as reviews of existing evidence and as mirrors of the philosophical preferences of their authors; as such, they quickly become obsolete. Theorizing will never substitute for observation and experimentation. As for life elsewhere, Hamlet said it best -- and our universe, with its quirkiness, backs him up:

*There are more things in Heaven and Earth, Horatio,
Than are dreamt of in your philosophy.*



Book Review:

After Contact

by Dr. Albert A. Harrison

(New York: Plenum, 1997, ISBN 0-306-45621-4)

reviewed by Melvin A. Lewis (m.lewis@ieee.org)

Recent discoveries of extrasolar planets and possible (though disputed) indications of fossilized life on meteorites from Mars, along with strong hints of liquid water under the ice on Europa, shifts the odds in favor of likelihood of life elsewhere. But what about intelligent life?

Written by a SETI League member and professor of psychology, *After Contact* is a book that essentially explains what to expect and what to do in the minutes, hours, days and even years after an ET signal is received. Prof. Al Harrison details the anticipated reactions by the scientific community, government agencies, the clergy, and John Q. Public. He spends some time covering people's views on the possibility of extraterrestrial intelligence, and the value of searching. Harrison outlines how historical events show us how we might react to the detection of a signal.

Of special interest to SETI League members, is an entire chapter devoted to microwave observation, defining the search space, recognizing a hit, and understanding the limitations of a radio search. Elsewhere in his fascinating book, Harrison discusses messaging, transmission control and dealing with the time delay.

There is much nonsensational discussion on the very nature of possible ET life forms and our conceivable reactions to discovery of civilizations "out there." He approaches this topic from the perspectives of anthropology, political science, psychology, and sociology.

The book, in spite of the title, is not a sequel to the movie starring Jody Foster as Dr. Arroway. Nor is it a technical manual on how to set up a listening post. Rather, it provides insight and guidance on cultural issues, the meaning (in this context) of the term communication, and what constitutes intelligence, perception, and consciousness. There is a chapter on false alarms, but it sets the record straight about UFOs and abductions, not signal processing.

Harrison further speculates (and rightly so) on the human capacity to even discern a message from an advanced civilization. We might even ignore it as being background noise, it turns out. This could be a problem with a spread spectrum signal, for example. He also suggests that the ETs might live at a much different time rate, and the information in their messages would be beamed at perplexingly slow or blindingly fast rates. He also points out that, while we are convinced that we are numero uno, communications wise - here on Earth, we cannot expect to hold that position in the galaxy.

In this reviewer's opinion, Harrison is all too brief in his suggestions for building support for SETI; nonetheless, this is an excellent and optimistic book for the serious SETI enthusiast. His careful and thorough treatment of the topic, along with 25 small font pages of references, makes it an authoritative work, well worth the \$29 price (at 363 pages, hardcover, Plenum Press). ❖

First Announcement and Call for Papers:

SETI League Technical Symposium and Annual Membership Meeting

In accordance with Article IV, Section 1 of our duly approved Bylaws, as amended, the Trustees of The SETI League, Inc. hereby schedule our Seventh Annual Membership Meeting for 10 AM Eastern time on Sunday, April 29, 2001. This year, for the first time, the Annual Meeting will be preceded by a one-day SETI League Technical Symposium, which will run from 9 AM to 5 PM on Saturday, April 28, 2001. Both events will be hosted by the Engineering Department of The College of New Jersey, Trenton NJ. An informal SETI League dinner will be held Saturday night, at a place yet to be determined. Further details will be posted on The SETI League website as they become available.

We hereby solicit Technical Symposium presentations on SETI-related hardware, software, search strategies and philosophy. This notice serves as a first Call for Papers. Those SETI League members wishing to present a paper should email a proposed title and 100-word abstract to the executive director at n6tx@setileague.org, no later than 1 January 2001. Be sure to include your full name, affiliation, postal address, and email address. A formal Proceedings will be published for distribution at the Symposium. Camera-ready copy or suitable word processor files will be due no later than 1 March 2001. Instructions for submission of manuscripts will be sent to those submitting accepted abstracts, probably in mid-January.

As attendance by one percent of the League's membership constitutes a quorum, all members in good standing are encouraged to attend the Annual Meeting. Per Article IV, Section 3 of our Bylaws, written notice of this Meeting is being mailed to all members in good standing, not less than ten days nor more than sixty days prior to the meeting date. Members are encouraged to submit additional Old Business and New Business items for inclusion in the Agenda. Please email your agenda items to n6tx@setileague.org, no later than 1 March, 2001. ❖

Bruno Nominations Now Due

Nominations for the 2001 Giordano Bruno Memorial Award, The SETI League's highest honor, are due by 1 January, 2001. Named in memory of the Italian monk burned at the stake in 1600 for postulating a multiplicity of inhabited worlds, the Brunos are awarded for significant contributions to the art and science of SETI. Neither nominator nor nominee need be SETI League members, although a written nomination, citing the contributions of the nominee, is required.

The 2001 Bruno Award winner will be announced at our Seventh Annual Membership Meeting on Sunday, 29 April 2001. Past Bruno recipients include:

1996 - Dr. D. Kent Cullers, WA6TWX

1997 - Daniel Boyd Fox, KF9ET

1998 - Ken Chattenton, G4KIR; Trevor Unsworth, G0ECP

1999 - Noel Cedric Welstead, VK4AYW

2000 - Dr. Stuart Kingsley

Please email your 2001 Bruno award nominations now to bruno@setileague.org, fax them to 1 (201) 641-1771, or mail them to SETI League headquarters. ❖

What a Difference a Decade Makes

by H. Paul Shuch, Ph.D., Executive Director

I've just finished reading *Are We Alone In The Universe?* (ISBN 0-671-03892-3, 1999). When the initial version of this book (then titled *First Contact*) appeared in 1990, NASA was in the SETI business bigtime. Their proposed two-pronged project, budgeted at a modest \$12 million annually (about 5¢ per US citizen per year), included a sensitive targeted search of the nearest 1,000 sun-like stars, as well as a systematic all-sky survey of the entire cosmos for intelligently generated microwave emissions.

But how swift blow the winds of change! After having endured Sen. William Proxmire's notorious Golden Fleece Award, the searchers at NASA came to realize that SETI, at least in government circles, had become a four-letter word. Their ambitious search actually did go online in October of 1992, under the new designation HRMS (for High Resolution Microwave Survey). The subterfuge fooled no one in Washington. SETI by any acronym remained political suicide, and just one year later Congress pulled the funding plug on NASA's "hunt for little green men."

And had the story ended here, there would have been little reason for Ben Bova, Prof. Bill Alschuler and their colleagues to come up with *Are We Alone In The Cosmos?* Fortunately for its fans, SETI is the science that refused to die.

Are We Alone is a collection of eighteen essays, articles, and short stories dealing with the search for life in space. This revision retains some of the content of *First Contact* intact. Others of the original contributions appear in expanded and updated form. And a few new submissions grace the pages of this edition, which bears the timely subtitle "the search for alien contact in the new millennium."

Many of the authors contributing to this collection are well known to SETI enthusiasts. David Latham, Thomas McDonough, Frank Drake, Michael Klein, Tom Van Horne, Michael Papagiannis, Kent Cullers, Paul Horowitz, Michael Michaud and Philip Morrison are all household names within the very small family of radio astronomers. Other contributors, such as Ben Bova, Isaac Asimov, Hal Clement, David Bryn, Gregory Benford and Arthur C. Clarke, are icons in the world of science fiction. That no fewer than eight of the contributors belong to The SETI League should in itself make this book mandatory reading for fellow members.

Are We Alone shares with its predecessor the obligatory coverage of cosmology, planetology, the Drake Equation, and the Fermi Paradox. New this time around are discussions of such timely topics as the privatization of SETI, Optical SETI, Project Phoenix, the SETI@home experiment, and (most notably for readers of this review) The SETI League. Though by no means exhaustive (this is, after all, a collection of *short* essays), the additions add a sense of immediacy to what might otherwise be a sterile history.

Speaking of which, history will record that it was the original edition of this work that led to the formation of The SETI League. In their chapter "Individual Involvement," Kent Cullers and Bill Alschuler told of how amateur radio astronomers might contribute to SETI, and how coordination of amateur efforts

would be needed to promote quality and standardization. "No such organization currently exists," they wrote in *First Contact*. Four years later, The SETI League was cast from the mold they crafted in 1990. In reporting the emergence of The SETI League, the updated "Individual Involvement" chapter rightly claims its fair share of the blame for our existence.

Appendix A to *First Contact*, titled "Amateur Equipment for SETI," outlined the basics for pulling together an effective amateur radio telescope. That book recommended that interested amateurs employ the then-new Icom 7000 receiver. If that particular designation rings familiar to SETI League members, it is because the Icom 7000 was the receiver of choice for the first half-dozen Project Argus stations. In fact, it would be fair to say that Appendix A formed the basis for *The SETI League Technical Manual*. His many other accomplishments notwithstanding, this fact alone qualified Cullers for the very first Giordano Bruno Award, which he received from The SETI League in 1996.

It is worth noting that Appendix A to *Are We Alone* also discusses amateur SETI gear, from the contemporary perspective. I am pleased that in this version, Cullers and Alschuler refer readers to The SETI League website for information on selecting their required hardware and software. So it seems we've come full circle.

What a difference a decade makes!



SETI League Leader Joins International Science Committee

RIO DE JANEIRO, BRAZIL..., October, 2000 -- The head of a leading association of amateur radio astronomers has joined the international scientific body which plans for the eventuality of extraterrestrial radio contact. H. Paul Shuch, executive director of the nonprofit SETI League, Inc., was appointed to serve on the SETI Post-Detection Subcommittee of the International Academy of Astronautics, at last week's International Astronautical Congress in Rio de Janeiro, Brazil. Under Shuch's leadership, The SETI League's 1,200 members in sixty countries search for credible optical and radio evidence of intelligent life in space.

"Scientific rigour is important to amateur and professional observers alike," notes Prof. Ray Norris, the Australian astrophysicist who serves as the Subcommittee's chairman. "The amateur community brings resources which will greatly aid the SETI endeavour. Dr. Shuch's participation on this committee will strengthen our tradition of close collaboration between the amateur and professional SETI communities."

In addition to his scientific credentials, Dr. Shuch is a lifelong amateur radio operator, a noted microwave experimenter, and a leader in the amateur communications satellite community. A retired engineering professor, he was tapped to head up The SETI League at its inception in 1994.

SETI scientists seek to determine through microwave and optical measurements whether humankind is alone in the universe. Since Congress terminated NASA's SETI funding in 1993, The SETI League and other scientific groups have been attempting to privatize the research.



Guest Editorial:

E.T. or Alien?

The Character of Other Intelligence

by David Darling, Ph.D. (darling@uslink.net)

Science fiction has envisaged the possibility of everything from kind, wise, and even cute extraterrestrials, like *E.T.*, to utterly malicious, scheming monsters, like Giger's *Alien*. On balance, ever since H. G. Wells unleashed his marauding Martians, the fictional creatures from "out there" have tended to be of the usurping, death-ray variety - not surprisingly, since this makes for a more compelling plot. But if we do encounter other intelligences among the stars, will they in reality prove to be friendly or hostile?

A poll conducted by the Marist Institute in 1998 suggested that 86 percent of Americans who think there is life on other planets believe it will be friendly. Similar optimism has been expressed by many prominent figures in SETI, including Frank Drake, Philip Morrison, and Carl Sagan. An argument in favor of alien beneficence is that any race which has managed to survive the kind of global crises currently facing humanity (and which presumably confront all technological species at some stage in their development) is likely to have resolved the sources of conflict we still have on Earth. Morrison, for instance, doubted that advanced societies "crush out any competitive form of intelligence, especially when there is clearly no danger." Similarly, Arthur C. Clarke has stated that: "As our own species is in the process of proving, one cannot have superior science and inferior morals. The combination is unstable and self-destroying."

However, there can be no assurance on this point. After all, human beings appear to have made little progress, over the past two millennia or so, toward eliminating or controlling their aggressive tendencies. And there is no reason to suppose we shall change much in this respect over the next few centuries, during which time we may well develop the means of reaching the stars. Those who are pessimistic about the general nature of extraterrestrials argue that Darwinism, and its fundamental tenet "survival of the fittest," virtually guarantees that any advanced species will be potentially dangerous. Michael Archer, professor of biology at the University of New South Wales, Australia, has put it this way: "Any creature we contact will also have had to claw its way up the evolutionary ladder and will be every bit as nasty as we are. It will likely be an extremely adaptable, extremely aggressive super-predator."

Perhaps the most reasonable assumption, in the absence of any data, is that, just as in our own case, the potential for good and evil will exist in every intelligent extraterrestrial race. Civilization is unthinkable without some measure of compassion, and yet how could a species that had emerged successfully after several billion years of live-and-let-die biological competition not also possess a ruthless streak? The question is surely not whether any advanced race we may meet among the stars is capable of aggression - it certainly will be unless it has genetically or otherwise altered itself to be purely pacific - but whether it has learned to override its more basic instincts. Bear in mind, too, the variation in character that can exist between individuals within a species. Will the first representative of an alien race that we encounter be a Hitler or a Gandhi? ❖

One Hundred Up, 4900 To Go!

A Project Argus Update

The SETI League, Inc. launched its *Project Argus* all-sky survey in April 1996, with the ambitious goal of real-time all-sky coverage. This SETI experiment is unique in that it employs the talents and energies of thousands of dedicated amateur radio astronomers worldwide. In its first four years, *Project Argus* has grown from five small prototype radio telescopes to one hundred operational stations, with hundreds more under construction. We are still decades away from our projected 5,000 stations able to see in all directions at once. Nevertheless, much has been learned about how to build radio telescopes on the cheap, operate them with the utmost of professionalism, and interpret received data with scientific rigor.

A paper presented by Dr. Shuch to the 51st International Astronomical Congress in October reviews the design criteria of the basic *Project Argus* station, and shows how it achieves sensitivity on a par with the very best professional facilities of a quarter century ago. The challenges of signal verification and global participation are discussed. Several interesting candidate signals are shown (none of which passed our rigorous tests for intelligent extra-terrestrial origin). An extrapolation of current *Project Argus* technology into the next few decades demonstrates the evolutionary nature of amateur radio telescopes and their power in a coordinated global search. ❖

SETI League Receives Moonbounce Grant

LITTLE FERRY, NJ., August, 2000 -- The SETI League, Inc., nonprofit leaders in the search for life in space, has received a Small Equipment Grant from the American Astronomical Society, to help it construct a transmitter to bounce microwave signals off the surface of the moon. The project, titled "A Lunar Reflective Test Beacon for Radio Astronomy and SETI," will enable amateur and professional radio astronomers alike to calibrate their receiving systems, by providing a stable reference signal emanating constantly from a known point in the sky.

The SETI League's 1200 members in sixty countries have collectively assembled 95 small radio telescopes, constructed by individual members out of discarded satellite TV dish antennas, along with sensitive microwave receivers and powerful home computers. Traditionally, radio telescopes are used to study the structure of the universe by analyzing microwave radiation emitted by natural astrophysical phenomena. In the SETI application, it is artificial radiation from other technological civilizations that the telescopes seek to identify. In either case, test signals, such as the one to be provided by the moonbounce beacon, enable radio astronomers to confirm the proper operation of their equipment.

The SETI League's grant application was accompanied by letters of support from the Planetary Society, the California-based SETI Institute, and the National Radio Astronomy Observatory. "With the support of our colleagues, plus this generous assistance from the AAS," comments SETI League executive director H. Paul Shuch, "we should be ready to start bouncing interesting microwave signals off the lunar surface early in 2001." ❖

Extracom Not Representative of Brazilian SETI Community by Mauro J. Cavalcanti and Claudio Brasil

Recently, you may have seen in the SETI news mention of a Brazilian group of amateur astronomers prepared to launch "Extracom," an Active SETI effort that they claim is "the first private extraterrestrial communication initiative." Their initial announcement proclaimed that "it is time to join the great galactic community. It is time to speak freely from Earth to the whole universe." Extracom spokesman Mr. Eraldo B. Marques says of the project:

We wanted to shine a little light in the heads of those who might never have thought of it (if we can do it in Brazil, just imagine what you can do on the right side of the map!)...

We think it is a selfish position and a waste of precious time just to be waiting for a message (from the ETI's Extracom) while not giving out anything in exchange ... Had a project like ours been launched by Frank Drake's team in the late 60's, we could be closer to the moment of receiving a reply by now.

EXTRACOM ... expresses a legitimate and sincere desire of doing something great and meaningful, in an independent way. You can call it a liberal enterprise designed to celebrate the individual freedom.

We are ... a group of passionate free thinkers and private researchers. One of our manifest goals is exactly to be an off-academy group.

The authors are involved in SETI research here in Brazil for several years. One of us (Claudio Brasil) is the official Brazilian Regional Coordinator of The SETI League, with a Web page indexed in the main Brazilian search engines and regular appearances in the press. He also edits "Comunidade SETI," the first (and, as far we know, the only) SETI newsletter in Brazil. Mauro Cavalcanti maintains the **Toucan*** Web site on SETI & Exobiology, launched in 1998. We have been in frequent contact with each other over the last two years, but had never heard about the "Extracom" project or the GIRA group until recently, nor has anyone from that group contacted us.

We hereby state that the "Extracom" group does *not* represent the full SETI community in Brazil and that we do *not* endorse the positions of that group at all. We welcome collaborative work and are open to cooperate on a constructive basis with anyone committed to serious SETI research here in Brazil, but cannot agree with the positions stated by that group.

We are strongly committed to a professional approach to SETI, holding an academic, scientifically well-founded, view of the subject. Besides the above mentioned newsletter edited by Claudio Brasil, we are also currently engaged in the preparation of a multi-authored volume on SETI, which will be the first book of the genre in Brazil. Therefore, we do NOT want to keep an "off academy" position, and indeed are both working full time (while not in SETI research, unfortunately!) at large public re-

search institutions. (Claudio Brasil is a physicist at *Instituto de Pesquisas Energeticas e Nucleares*, Universidade de Sao Paulo; and Mauro Cavalcanti is a fellow research biologist at *Museu Nacional*, Universidade Federal do Rio de Janeiro).

We do *not* agree that the current SETI research (both microwave and optical) is a "selfish position and a waste of precious time." We also want to fully honor the pioneering efforts of Dr. Frank Drake, and it is our firm hope that someday in the (near?) future his Project Ozma will be enlisted among the greatest scientific efforts of all times (if not for its results, for it having laid the foundations of the truly scientific SETI.)

While we also share "a sincere desire of doing something great and meaningful," we do **not** want to do so in an "independent way." Cooperation and concerted efforts are truly essential in an activity of such overwhelming importance as SETI. We see science (including scientific SETI) as a worldwide collective enterprise, and not as "a liberal enterprise designed to celebrate the individual freedom" of someone (THAT would be a "selfish position"!). As a constructive human activity, science "celebrates the individual freedom" by recognizing each true contribution made by a scientist to the mankind's knowledge pool, after a quite healthy process of peer-reviewing and careful evaluation and independent confirmation of every bit of evidence. As Carl Sagan (and, by the way, several of the major philosophers of science) pointed out, this is what makes science a self-correcting enterprise and clearly distinguishes it from religious belief.

In this connection, it is our opinion that such "independent" SETI initiatives as Project Phoenix, Project Argus, and COSETI should not be misunderstood and overstated as "liberal enterprises designed to celebrate the individual freedom," as they are indeed a consequence of the regrettable lack of official support to SETI research by the major public scientific institutions. We therefore endorse all initiatives to restore public support to scientific SETI, such as the Petition to Restore NASA SETI Funding issued by Tobias Daniel Wabbel, seen in an earlier issue of this Newsletter.

Furthermore, we feel that initiatives involving "active contact" are not in accordance with the *Decision Process for Examining the Possibility of Sending Communications to Extraterrestrial Civilizations* document drafted by the IAA SETI committee, which explicitly states:

No communication to extraterrestrial intelligence should be sent by any State until appropriate international consultations have taken place. States should not cooperate with attempts to communicate with extraterrestrial intelligence that do not conform to the principles in this Declaration ... if a decision is made to send a message to extraterrestrial intelligence, it should be sent on behalf of all humankind, rather than from individual States.

We think these recommendations should apply not only to individual States but also to private organizations and individual persons.

Last, but hopefully not least, we also do not believe that a map has any "right sides" (what is the "right side" of a planet, anyway?).



Software Corner:

**SETISEARCH - An open source
real-time SETI program for Linux**
By Jenny Bailey (email: jennyb@jsquared.co.uk)

There are many FFT programs available, and some designed specifically for SETI use. I have started setisearch with specific reasons in mind.

- Open source: much of the code should be reusable under any O/S. This can be used as a library for anyone else's project.
- Modularized: the program can easily be modified for other input - such as external DSP card.
- Separate display: my plans to use a remote telescope for piggy-back SETI, the data processing can be done close to the telescope, and the display can be seen over an internet connection.
- Language: ok, so I should have used c++, however I am more familiar with c and I wanted to finish this sooner rather than later. Further to this, I have been persuaded to compile the program with g++ (GNU c++) because the warning messages are more pedantic.

Intended audience

This program is not another SETIFOX - an excellent SETI program written by Dan Fox for SETI for use with DOS or Windows. However, I dream that setisearch will be the equivalent Linux package in a couple of years.

Initially I hope that Linux enthusiasts will overcome the hurdles to get this program installed and working (this is not for the faint-hearted). As the program matures - it will become more user friendly and also distributed as an rpm (or .deb or whatever - we don't go in for distribution wars here.)

There is a lot of techie ability and enthusiasm in the Linux community and drawing some of this towards the SETI community would be no bad thing.

Functionality

The functionality will become available in Phases:

Phase 1 - Basic operation

- Supports SB16 compatible in mono mode using Linux /dev/dsp interface
- AGC of input signal using mixer level control
- Two-buffer arrangement to reduce data loss when windowing
- Calculate target position (RA and Elevation) in real time
- Normalize mode to flatten receiver audio path response
- Averaging and Peak detection
- Logging of 'Hits'
- Separate display program connects to main program via socket (could be over network/ internet)
- documentation

Phase 2 - Useful Functionality

- Frequency scanning to IC-R7000, FX5000 and any other radios that I can get hold of
- Stereo
- Single Linux floppy distribution - see Mulinux, LRP etc.

- Hard programmed response on signal detection - Alarms, aerial movement - all by wagging parallel port
- rpm distribution

Phase 3 - Customizable Response

- Simple programming interface to add new radio protocols (for scanning)
- Simple customizable actions on receipt of signal - move aerial, frequency, send email, fax etc.
- Support more than one soundcard

Phase 4 - Increased Capacity

- Interface to sharc development kit - for more bandwidth

Design

Audio is taken from the /dev/dsp device. This is the soundcard A/D converter and it is programmed to supply a stream of 16 bit words. The hardware and data management of /dev/dsp is taken care of by the Linux Kernel.

The first problem was that this device will supply data at the sample rate (default 8000 samples/second), and then, once the program wanders off to process these results, any further data from this device is lost for the duration of the calculation. It was therefore decided that the program should be multithreaded.

Reading Thread:

Data is taken in from /dev/dsp in a block size of $\text{fftlength}/2$. This thread blocks until the required length of data is received. This buffer is then marked as full.

Processing Thread:

Consider an example in which we use an fftlength of 1024 bytes. As each fft is performed on two samples (to recover some of the data loss due to windowing), the sample size is 512. The soundcard is in 16 bit mode, so each buffer consists of words.

An FFT and bit reverse is performed on the target buffer. This buffer consists of both real and imaginary parts (each stored as float). Real magnitude values of the sampled waveform are stored in the real part of the array, imaginary parts are set to zero.

After the FFT and bit reverse, the bin level consists of both real and imaginary parts. The magnitude is the square root of the sum of the real (squared) and imaginary (squared) parts. The phase information can be discarded (unless anyone can think of a good use for it).

We don't bother with the squared root, as this is unnecessary because we are looking for relative peaks. A number of these results are added into the average buffer, and then divided by the average number (probably unnecessary again).

The normalizing process is designed to take a standard receiver response (peaking at 1KHz, tailing off to each side because of receiver filtering) and flatten it where possible, and removing response where there is not enough level. This will greatly help the peak detection.

Normalizing involves running setisearch for a few minutes (on the target receiver with no signal) to get a nice noise response. This response is then saved in a file. The contents of this file are then used to 'flatten' the receiver response.

This paper is intended as a brief introduction only. Further information about setisearch, along with downloadable open-source code, is available online, at <http://www.setisearch.org>.



Hardware Corner:

SETI Range Revisited

by Malcolm C. Mallette (mallettem@home.com)

There has been much recent speculation on The SETI League's various email discussion lists of the SETI range of radio telescopes.

To determine the SETI range of radio telescopes, it is necessary to make assumptions about the transmitter power and dish size of the ETI's transmitting system. Planetary radar is one use of radio that ETI is unlikely to find a substitute for. By determining the power into the Arecibo dish necessary to have a planetary radar system capable of determining the exact orbit of an asteroid at a reasonable distance from Earth, it is possible to determine the power level and dish size that would give a reasonable ETI the ability to safeguard its planet by knowing the exact orbit of asteroids that might strike the planet. Using that information, I calculated the range of small SETI dishes in theory in the article *Small Parabolic Dish Antennas and SETI*, which was published in the November/December 1996 issue of *Radio Astronomy*, the journal of the Society of Amateur Radio Astronomers. I have received no comments indicating an error in the article.

However, knowing the range of a small dish antenna in theory does not mean that you know the actual range of a particular real dish when used for SETI. Real dishes are not perfect in shape, are not perfectly 100 percent (or even 50 percent) illuminated, and are subject to interference. When we had the radio telescope at the University of Indianapolis running, in a high interference area, it was necessary to determine its range in a SETI project.

It is possible to determine the SETI range of a real radio telescope by determining the flux of the smallest object it can observe. How to do that is explained in *Radio Telescopes, A Simple Method of Comparing Their Performance and Determining Their SETI Range*, published in March/April 2000 *Radio Astronomy*. A copy of that article is also on The SETI League website. It should be noted that the first article is pure theory, based on an ideal dish with 50 or 60 percent illumination and no interference! The later article is the practical one.

The only critical comment I received about the later article was a suggestion by a radio astronomer at Arecibo, who had just been employed by the SETI Institute. He claimed that the radio astronomy (not SETI) formula for the minimum detectable flux I had used from *Radio Astronomy*, 2nd edition, by John Kraus, did not take into account determining the detection of a minimum flux by examination of the graph of the data over a period of time before, during and after the minimum detectable flux was in the beamwidth of the dish. He considered that to be a kind of visual integration of the data beyond the electronic integration time. I found that critical comment to be without merit, considering the graph which is Fig 3-15, in *Radio Astronomy* 2nd edition. That graph shows a typical radio telescope record of the minimum detectable flux as a graph of data before, during and after the minimum flux was in the beamwidth of the dish. See the development of the formula for minimum detectable temperature variation and minimum detectable flux at page 3-44 of *Radio Astronomy*, 2nd edition.

I hope these articles, especially the latter, are helpful to those considering using a radio telescope for SETI. I would ask anyone who actually analyzes the possibility of using a particular radio telescope for SETI and finds it is not adequate to consider using a larger dish instead of giving up on the search. The inadequate radio telescope will be great for learning radio astronomy techniques and related matters in preparation for the day the large dish is acquired. ❖

Event Horizon

SearchLites' readers are apprised of the following conferences and meetings at which SETI-related information will be presented. League members are invited to check our World Wide Web site (www.setileague.org) under *Event Horizon*, or email to us at info@setileague.org, to obtain further details. Members are also encouraged to send in information about upcoming events of which we may be unaware.

January 1, 2001: The 21st Century *Really* Begins

January 12 - 14, 2001: *Arisia '01*, Boston MA.

January 22 - 24, 2001: *OSETI III*, Third International Conference on Optical SETI, San Jose CA.

February 16 - 18, 2001: Boskone 38, Framingham MA.

March 2 - 4, 2001: *Contact 2001*, Santa Clara CA.

April 21, 2001: Third annual SETI League Ham Radio QSO Party, 14.204 MHz.

April 28 - 29, 2001: SETI League *Technical Symposium and Annual Membership Meeting*, Trenton NJ.

May 18 - 20, 2001: *Dayton Hamvention*, Dayton OH.

May 25 - 28, 2001: *Balticon 35*, Baltimore MD.

July 26 - 29, 2001: *Central States VHF Conference*, Ft. Worth TX.

August 30 - September 3, 2001: *Millennium Philcon World Science Fiction Convention*, Philadelphia PA.

October 1 - 5, 2001: *52nd International Astronautical Congress*, Toulouse, France.

October 5 - 6, 2001: *19th AMSAT Annual Meeting and Space Symposium*, Atlanta GA.

October, 2001 (date TBA): *Microwave Update*, San Jose CA.

May 17 - 19, 2002: *Dayton Hamvention*, Dayton OH.

August, 2002 (date TBA): *Bioastronomy '02*, Hamilton Island (Great Barrier Reef), Australia.

October, 2002 (date TBA): *Microwave Update*, Washington DC.

May 16 - 18, 2003: *Dayton Hamvention*, Dayton OH.

October, 2003 (date TBA): *Microwave Update*, Seattle WA. ❖

Keeping Score

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Total:	1213	99	61
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