MOUNTAIN
SPARK
GAPS

NPARC—The Radio Club for the Watchung Mountain Area

Website: http://www.nparc.org
Club Calls: N2XJ, W2FMI
Facebook: New Providence Amateur Radio Club ((NPARC)

VOLUME 53   NO. 4 April 2018

UPCOMING EVENTS

Tri County RC
Fox Hunt
Sunday June 3

New Providence Memorial Day Parade
Monday May 28
See Inside

Regular Meetings

5/14 & 5/28?
Monday 7:30
DeCorso Community Center

Meeting Schedule

Regular Meeting: 7:30—9:00 PM
2nd Monday of each month at the
NP Senior & Adult Center
15 East Forth Street
New Providence

Informal Meeting: 7:30—9:00 PM
4th Monday of each month
Same location
Everyone is Welcome
If a normal meeting night is a holiday,
we usually meet the following night.
Call one of the contacts below
or check the web site

Club Officers for 2018

President: W2PTP Paul Wolfmeyer
201-406-6914
Vice President:K2GLS Bob Willis
973-543-2454
Secretary: K2AL: Al Hanzl
908-872-5021
Treasurer: K2YG Dave Barr
908-277-4283
Activities: KA2MPG Brian Lynch
973-738-7322

On the Air Activities

Club Operating Frequency
145.750 MHz FM Simplex

Sunday Night Phone Net
Murray Hill Repeater (W2LI) at 9:00 PM
Transmit on 147.855 MHz
With PL tone of 141.3 Hz
Receive on 147.255 MHz
Net Control K2AL

Digital Net
First & Third Mondays 9 PM
28,084 — 28,086
Will be using PSK and RTTY
Net control K2YG

Club Internet Address

Website: http://www.nparc.org
Webmaster KC2WUF David Bean
Reflector: nparc@mailman.qth.net
Contact K2UI, Jim

MOUNTAIN SPARK GAPS

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P.O. Box 813
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Editor: K2EZR Frank McAneny
Contributing Editors:
WB2QOQ Rick Anderson
W2PTP Paul Wolfmeyer
K2UI Jim Stekas

Climatological Data for New Providence for March 2018

The following information is provided by Rick, WB2QOQ, who has been recording daily weather events at his station for the past 36 years.

TEMPERATURE -
Maximum temperature this March, 60 deg. F (March 1, 30)
Last March(2017) maximum was 70 deg. F.
Average Maximum temperature this March, 46.1 deg. F
Minimum temperature this March, 22 deg. F (March 17)
Last March(2017) minimum was 11 deg. F.
Average Minimum temperature this March, 29.4 deg. F
Minimum diurnal temperature range, 5 deg. (35-30 deg.)3/21;(37-32)3/7
Maximum diurnal temperature range, 30 deg. (55-25 deg.) 3/26

Average temperature this March, 37.8 deg. F
Average temperature last March, 37.4 deg. F

PRECIPITATION -
Total precipitation this March – 23.2” snow; 4.41” rain/melted snow
Total precipitation last March – 10.7” snow; 4.81” rain/melted snow

Maximum one day precip. event this March - March 7, 16.0” snow; March 21, 6.0” snow
Measurable rain fell on 5 days this March, 9 days last March.
Measurable snow fell on 5 days this March, 2 day last March.

YTD Precipitation – 12.90” (includes rain + melted snow, as of 3/31/18)

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Rick Anderson
4/2/18
243 Mountain Ave.
New Providence, NJ
(908)464-8912
rick243@comcast.net
Lat = 40 degrees, 41.7 minutes North
Long = 74 degrees, 23.4 minutes West
Elevation: 380 ft.
CoCoRaHS Network Station #NJ-UN-10

New Providence Memorial Day Parade

NPARC members are invited to participate in this years Memorial Day Parade, taking place on Monday, May 28. Our club has annually participated in this town event, for as long as I can recall; and a decent attendance in this club activity is requested. This is the one public event where hundreds of town's people get to see the club members, and a good attendance is most welcomed. Last year there was a small participation in our parade unit. As in past years, we request members to initially meet in the New Providence Memorial Library parking lot at 9:25 a.m., and we will truck pool over to our starting position on Central Avenue. Suggested dress code is club shirt, blue slacks, NPARC yellow cap, and of course your 2 meter HT, tuned to club frequency.

Our unit will walk the parade route, down Springfield Ave., between Central Ave. and Academy St. Please consider taking part in this community event.

Please contact Rick, WB2QOQ, if you will be participating in the parade or have questions. rick243@comcast.net; (908) 464-8911. Thanks Much !

Fox Hunt = Ham + Directivity

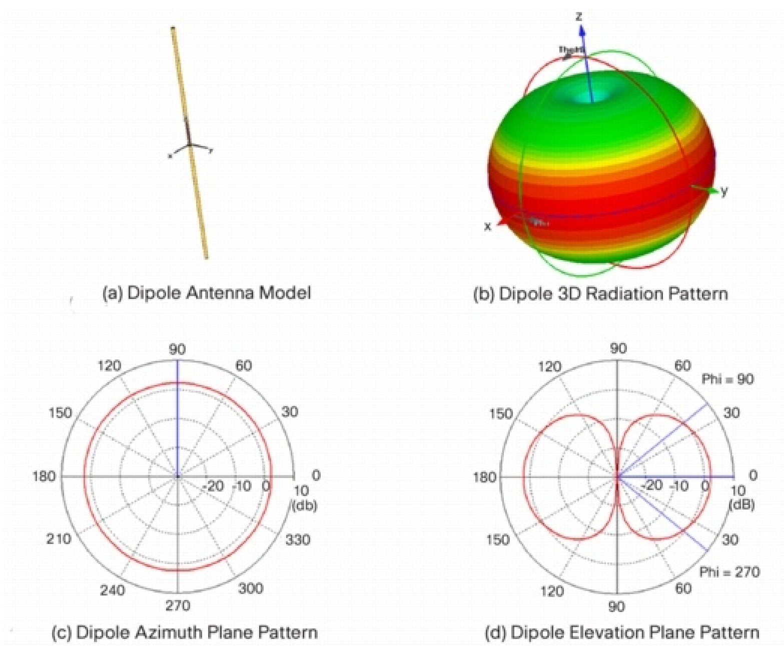
Jim Stekas - K2UI

As the day of the the Fox Hunt approaches there has been much discussion about gear and techniques for DF-ing the fox.   Regardless of the gear, DF-ing boils down to making bearing measurements and plotting them on a map. And the quality of the bearing measurements is directly related to the directivity of the antenna(s) used.

What is Directivity?

Directivity of a TX antenna is expressed by its radiation pattern, which is the relative power transmitted along different azimuthal and elevation angles. Thanks to the "reciprocity" of Maxwell's equations, the directivity of an antenna is the same on RX as on TX.

The figures above show the radiation pattern of a dipole antenna oriented along the Z-axis (vertical). The pattern is omni directional in the X-Y (horizontal) plane. This pattern applies to all dipoles less than ½ wavelength, regardless of size.   Since the electric field, $\vec{E}$, is along the wire, there is no radiation along the Z-axis because $\vec{E}$ and $\vec{B}$ of radio waves must be orthogonal to the direction of propagation. [1]



(a) Dipole Antenna Model

(b) Dipole 3D Radiation Pattern

(c) Dipole Azimuth Plane Pattern

(d) Dipole Elevation Plane Pattern

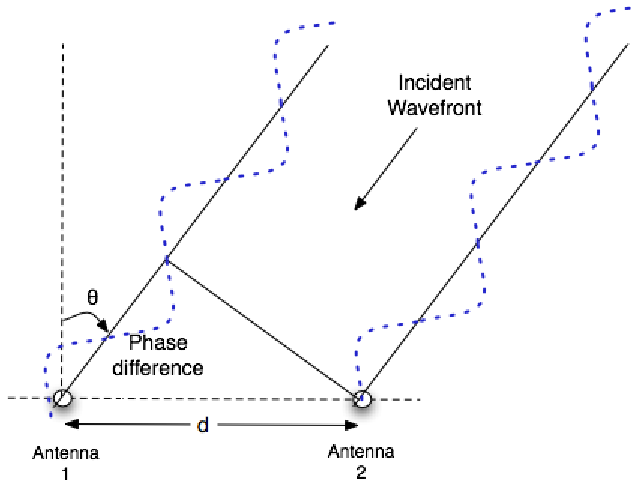
One *could* use a small horizontal dipole to measure bearing.   But if the fox is at VHF and is using a vertical antenna, a horizontal dipole would have a polarization mismatch that suppressed the direct propagation path and favored reflected and refracted waves. A better choice for VHF would be a small vertical loop which has the same radiation pattern as a small horizontal dipole but vertical polarization.

1   The energy flux of a radio wave is given by Poynting's vector, $\vec{S}=\vec{E}\,x\,\vec{B}$.

Directivity From Phasing

If we have multiple RX antennas separated by small distances, waves arriving from a distant TX will reach them at slightly different times.

The figure at right looks down on an array of two vertical dipole antennas. The wave in the figure arrives from the northeast at an angle θ and it passing A_1 slightly after A_2 because it must travel an extra distance L. This results in a relative phase difference $\phi_2-\phi_1=\Delta\phi$ given by $\Delta\phi=360^o\left(\frac{L}{\lambda}\right)$.[2]



Whenever L is an integer multiple of λ, signals at A_1 and A_2 are in phase. When L is an odd multiple of $\frac{\lambda}{2}$ the signals at A_1 and A_2 are exactly out of phase. Since $L=d\cdot\sin(\theta)$ can only take on values between $\mp d$, the range of L is $2d$ and therefore $\phi_2-\phi_1$ has a range of $360^o\left(\frac{2d}{\lambda}\right)$. The significance of this is that we have to insure $d\leq\frac{\lambda}{2}$ [3] to keep the range of $\phi_2-\phi_1\leq 360^o$. If the antenna spacing $d>\frac{\lambda}{2}$ we will generate additional peaks and nulls that give ambiguous bearing measurements.

Combining Antenna Signals

Suppose we combine antenna signals with a phase difference of $\Delta\phi$, we get $A_1+A_2=A_1+A_1\cdot e^{j\Delta\phi}$ with a total power of $|A_1+A_2|^2=|A_1|^2 4\cos^2\left(\frac{\Delta\phi}{2}\right)$.

The phase difference, $\Delta\phi=360^o\frac{d}{\lambda}\sin(\theta)+\phi_{TL}$, has a term due to relative propagation delay along bearing θ and another term due to an additional phase delay, ϕ_{TL}, we may add by using different transmission line lengths to connect A_1 and A_2 to the receiver.

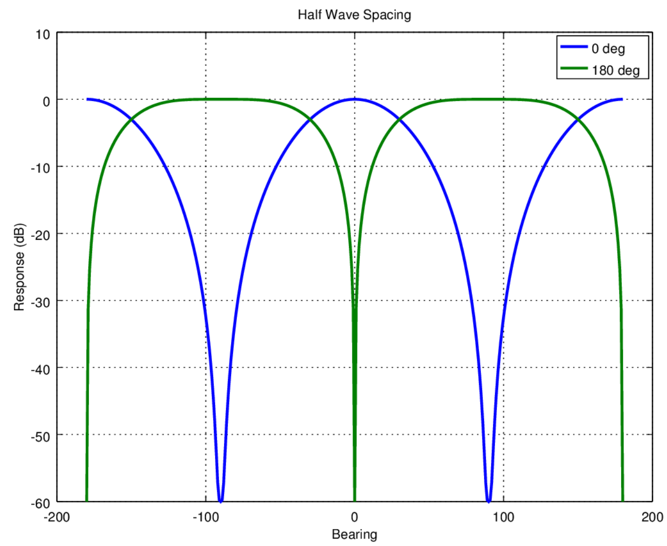
2 We express phase in units of degrees, since people who speak radians are also fluent in degrees.
3 This is the Nyquist sampling condition applied to spatial waves instead of temporal waves.

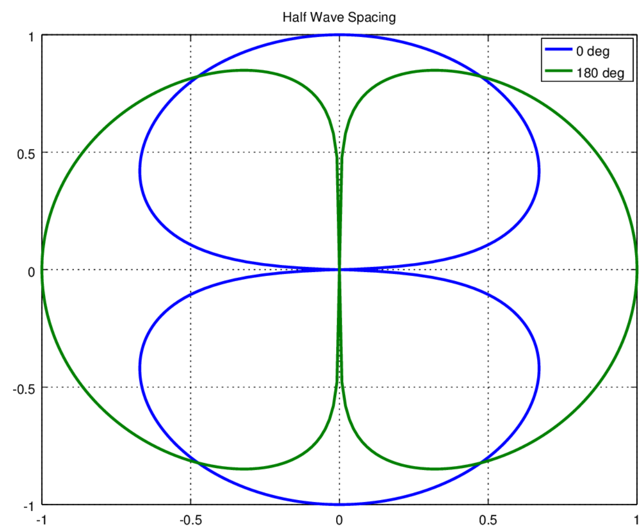
Assuming a spacing of $d=\frac{\lambda}{2}$ then $\Delta\phi=180^o \sin(\theta)+\phi_{TL}$ and the angular response is:

$$F_{\lambda/2}(\theta,\phi_{TL})=\cos^2\left(90^o \sin(\theta)+\frac{\phi_{TL}}{2}\right)$$

The figure to the right shows $F_{\lambda/2}$ for three different transmission line phasing choices:

- 0^o (blue) combines antennas in phase and generates a broadside peak and null at 90^o.
- 180^o (red) combines antennas out of phase and results in a sharp broadside null.





At left are polar plots of $F_{\lambda/2}$.

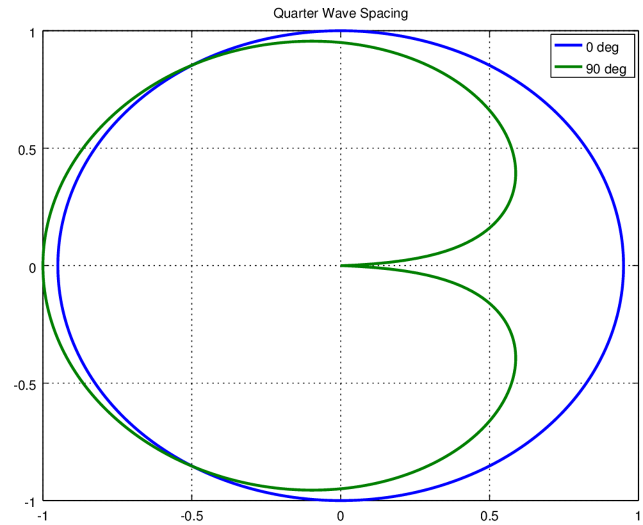
Note that the peaks and nulls are much sharper at broadside (0^o) than at end-fire (90^o). This is because the full width (aperture) of the antenna is presented at broadside while the width at end-fire goes to zero.

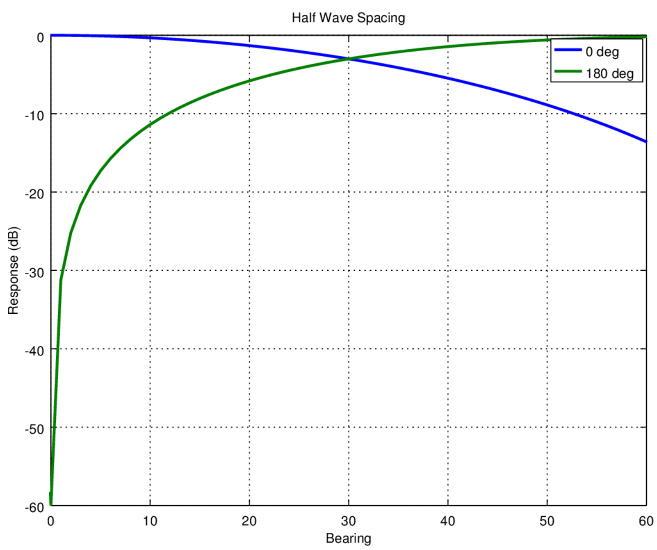
A DPDT switch can be used to flip the polarity of one antenna to switch between a 0^o and 180^o shift.

Cardiod Patterns

A cardioid pattern is one which has a sharp single null offset 180^o from a broad peak. To arrange for this to happen we need a spacing of $d=\frac{\lambda}{4}$ so that $\Delta\phi$ goes from -90^o to 90^o from end-fire to end-fire. Then we need to add and additional TL phase shift of 90^o so the total phase shift range is from 0^o to 180^o.

The resulting cardioid response is shown to the right in green. Without any transmission line phasing we would end up with an almost omni-directional pattern with only a few dB more gain at broadside than end-fire, which is not of help for DF-ing.





Systematic errors will probably dominate your DF performance, but it is interesting to consider what the fundamental bearing resolution of our antennas are. The figure at left shows what we can get from our pair of antennas at half wave spacing.

The null (green) seems to get infinitely narrow, only 1^o or so at -60dB. Fantastic precision if the signal you are tracking has an SNR > 60dB.

The formula for bearing resolution is $\sigma_\theta \approx 60^o \frac{\lambda/d}{S/N}$, which gives a pretty good description of the shape of the null, but it doesn't appear to have any relation to the peak (blue). Actually, the broad peak is just as good an estimator of bearing as the sharp null, but you'll need a computer to realize it. To see why, imagine fitting the bearing of the peak using power measurements at -10, 0, and 10 degrees. Your power measurement of S will be contaminated by N, but as S/N increases so do the quality of the power measurements and therefore the quality of the signal bearing fit.[4]

4 This isn't the optimum way to determine the bearing, but it isn't too bad.