MOUNTAIN
SPARK
GAPS

NPARC—The Radio Club for the
Watchung Mountain Area

Website: http://www.nparc.org
Club Calls: N2XJ, W2FMI

VOLUME 49 NO. 12, 2014

UPCOMING EVENTS

Regular Meetings
1/12 & 12/26
Mon. 7:30
NP C ommunityCenter

Kid's Day
Sunday 1/4/15
2PM to 5PM
New location:
NP Community Center
15 East Fourth Street

Annual Auction
Feb. 27
New Providence High School

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 Project 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

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Club Officers for 2015

President: KC2WUF David Bean
973-747-6116
Vice President:K2UI Jim Stekas
973-377-4180
Secretary: KD2EKN Tim Farrell
908-244-6202
Treasurer: K2YG Dave Barr
908-277-4283
Activities: W2PTP Paul Wolfmeyer
201-404-6914

—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
Details as announced.

Club Internet Address

Website:http://www.nparc.org
Webmaster K2MUN David Berkley
Reflector: nparc@mailman.qth.net
Contact K2UI, Jim

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MOUNTAIN SPARK GAPS

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Contributing Editors:
WB2QOQ Rick Anderson
WB2EDO Jim Brown

Climatological Data for New Providence for November 2014

The following information is provided by Rick, WB2QOQ, who has been recording daily weather events at his station for the past 33 years.

TEMPERATURE –
Maximum temperature this November, 69 deg. F (November 24)
Last November(2013) maximum was 67 deg. F.
Average Maximum temperature this November, 49.2 deg. F
Minimum temperature this November, 17 deg. F (November 19)
Last November(2013) minimum was 16 deg. F.
Average Minimum temperature this November, 32.6 deg. F
Minimum diurnal temperature range, 5 deg. (50-45 deg.) 11/6
Maximum diurnal temperature range, 26 deg. (59-33 deg.) 11/10;(64-38 deg.)11/11.

Average temperature this November, 40.9 deg. F
Average temperature last November, 41.3 deg. F

PRECIPITATION –
Total precipitation this November – 4.67” rain/melted snow; 3.0” snow
Total precipitation last November – 2.64” rain; Trace snow.

Maximum one day precip. event this month; November 17, 1.0” rain; Nov.26, 2.5” snow.
Measurable rain fell on 8 days this month, 10 days last November.
Measurable snow fell on 2 days this November, 0 days last November.
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Rick Anderson
12/8/14
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
12/8/14
243 Mountain Ave.

Serge Schelkunoff and the Transmission Line Analogue

Jim Stekas - K2UI

In 1873, after more than 10 year of work, James Clerk Maxwell published "A Treatise on Electricity and Magnetism" which unified electromagnetic theory in 20 equations (later reduced to their modern form by Oliver Heavyside). Buried deep within these equations are the solutions describing antennas but it would take the better part of the next century to uncover them.

Although the laws of physics well describe the world around us, there are surprisingly few problems that can be solved exactly. There are several methods used to attack intractable problems:

Find a similar problem that can be solved exactly and solve that.
Approximate the solution as a sum of different "modes" (e.g. harmonics)
Perform a numerical simulation using a computer.

Early in the 20th century it was know that the voltage and current propagated on an infinitely thin antenna wire as sinusoidal traveling waves. This approximation allowed the radiation resistance near resonance to be calculated but not the reactance. Steinmetz tried assuming that the antenna radiated power uniformly over it's length, but that led nowhere.

Enter Serge Schelkunoff, a Russian who made it across Lenin's USSR during WWI, to Japan, across the Pacific to Seattle, and finally to New York. After receiving a PhD in Math from Columbia in 1928, Schelkunoff joined the Western Electric Research Labs were he worked on the theory of waveguides and coaxial cable. Solutions for the E&M field in a waveguide were manageable only when its geometry was a simple function of the coordinates, i.e having a rectangular or circular cross-section. Applying this insight to antennas, Schelkunoff recognized that trying to match the voltage and current on a cylindrical wire to a spherical radiation field was the source of much mathematical complexity. To get around this problem he adopted approach #1, replacing the dipoles cylindrical wires with conducting cones with spherical ends which had current and voltage distributions expressible in spherical coordinates. In the limit of very thin cones his bi-conic dipole should be similar to a cylindrical wire dipole, but without the mathematical pathologies.

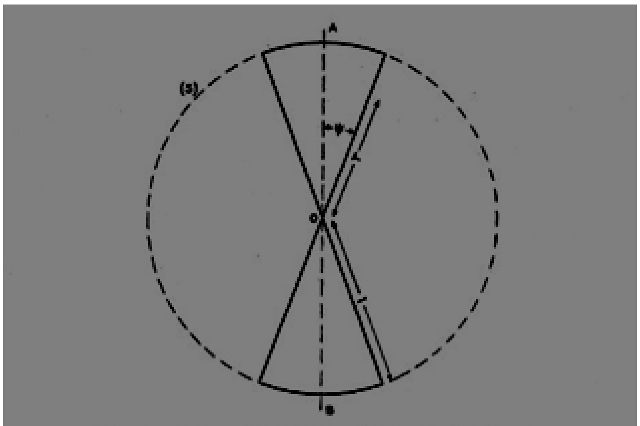
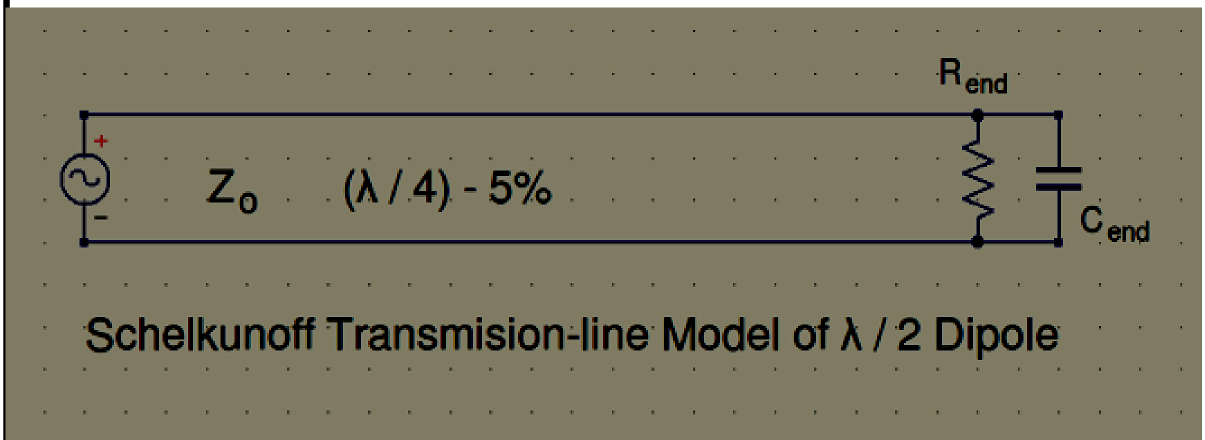


Fig. 5—The cross section of a conical antenna of length l and of the "boundary sphere" S.

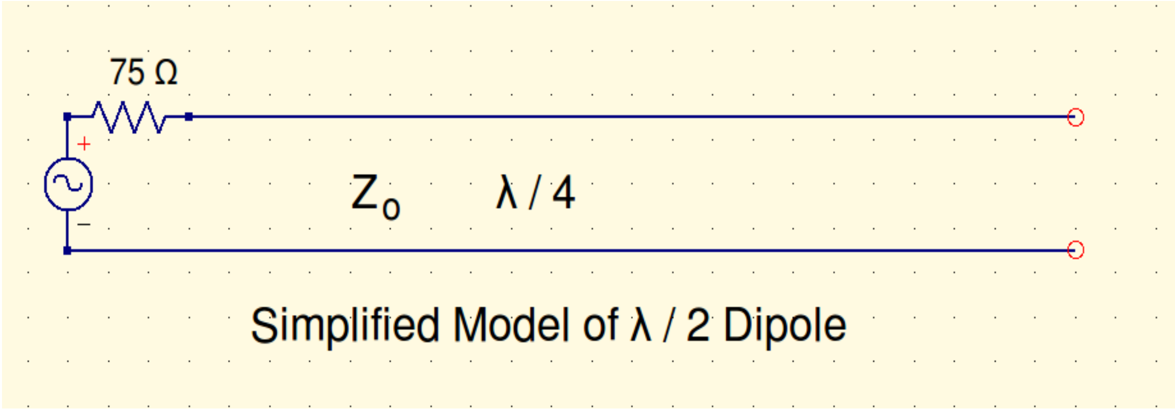
Schelkunoff found that the distribution of voltage and current on his bi-conic antenna are related as in a transmission line of length L with a characteristic impedance of:

$$Z_0 = 120\{\ln(2L/\alpha) - 1]$$

where 2L is the total dipole length and α is the average radius. (Note that for a λ/2 dipole, L=λ/4.) In Schelkunoff's view, the wave hitting the end of the antenna encounters a "radiation" resistance and a small end capacitance that is responsible for the "end effect" that causes dipoles to resonate at lengths about 5% shorter than a half-wavelength. The resulting model is



Schelkunoff's equations for R_{end} and $-C_{end}$ and are rather complicated but we don't really need to use them. For a λ/2 dipole we can use $R_{end} = Z^2_0 / R_{rad}$ where $R_{rad} = 75\Omega$ is the well known radiation resistance. Alternatively, we could replace R_{end} with 75Ω at the feed point, and remove $-X_{end}$ and "restore" the feedline to an electrical length of $L = \lambda/4$. The result is:



For the correct Z_0, the open feed line provides a rather good model of the reactance of the antenna, allowing calculation of the SWR as a function of frequency using the transmission line formula or a Smith chart. The insight gained from visualizing the impedance of an antenna on a Smith chart is a huge benefit of Schelkunoff's approach, but as soon as a second element is added the party is over!

Next month we discuss the work of R. W. P. King and his wire antenna solutions in terms of modes.

Reference links:

- http://jcoppens.com/univ/ucc/elmag/ant/pdf/ant_txl1.pdf – Summary article from Ham Radio.
- http://www.rainesengineering.com/articles/SimpleFormulasLoadedAntennas.pdf Example of using Schelkunoff's transmission line formula to calculate loading coil value.
- http://sharif.ir/~aborji/25149/files/Theory%20of%20Antennas%20of%20Arbitrary%20Size%20and%20Shape.pdf Schalkunoff's classic 1941 paper (a tough slog!).
- http://www.rainesengineering.com/articles/ForksInTheRoad.pdf A nice overview of Schelkunoff's approach and the history of early antenna theory.

Editors note:

If this is full of errors, blame me not Jim. Some symbols, subscripts and superscripts may be missing.

SCIENTIFIC TIDBITS

A NEW PRODUCT

EDS, maker of the CapAnalyzer 88A, has announced the new LeakSeeker 89 Autoranging Fault Locator model EDS-89, which replaces the original LeakSeeker 82B short and leaky fault locator. This unit was manufactured from 1995 to 2012.

The American-made LeakSeeker 89 locates the exact spot on a printed circuit board (to within a fraction of an inch) where a shorted or leaky component is bringing a power supply bus or data line to ground. It is able to locate defects from zero to 300 ohms with no loss of resolution. It can even find active shorts that a DVM will not show. The high GAIN mode can locate shorted components on multi-layer boards with ground planes and a power layer. Three fully automatic range settings allow easy finding of faults along thin, normal, or wide/ground plane copper PCB runs. A copy of the operation manual is available. For more detailed information check out their website: www.eds-inc.com. I cannot imagine the number of hours this will save us tinkerers.

A Transistor That Learns

Ever since John McCarthy coined the term "artificial intelligence" back in 1955, computer scientists have been trying to find ways of implementing it, both through hardware and software, while arguing about what the term actually means. Creating an intelligent machine that mimics the human brain is definitely a tall order. According to the University of Alberta's Professor Chris Westbury, a typical brain has somewhere in the neighborhood of 100 billion neurons, and all of them can fire about 200 times per second. This gives us an equivalent clock rate of 100 billion x 200 x 1000 = 20 million GHZ, and only uses 20W of power to do it; an incredibly efficient design.

One of the main advantages the brain has over traditional circuitry is that the more times a synapse fires, the stronger its connections become. In a word, it learns and transistors do not. At least they didn't until back in November of 2013, some materials scientists at the Harvard School of Engineering and Applied Sciences (www.seas.harvard.edu) created a new type of device that simultaneously modulates the flow of information in a circuit and physically adapts to changing signals. As described in the recent issue of Nature Communications, their synaptic transistor "could mark the beginning of a new kind of artificial intelligence: One embedded not in smart algorithms but in the very architecture of a computer."

According to co-lead author Jian Shi, "Each time a neuron initiates an action and another neuron reacts, the synapse between them increases the strength of its connection. And the faster the neurons spike each time, the stronger the synaptic connection. Essentially, it memorizes the action between the neurons."

The details are complicated, but basically a biological synapse employs calcium ions and receptors to learn, whereas the new device does the same thing with oxygen ions. As a result, it has a practically unlimited number of possible states rather than just "on" and "off." The challenge, as always, is to put the concept to practical use, but as the authors assure us, "This kind of proof-of-concept demonstration carries our work into the applied world where you can really translate these exotic electronic properties into compelling, state-of-the-art devices."

Here we come with personality built into computers, oh joy, oh gladness!

Jim WB2EDO