

**High
Frequency
Terrain
Assessment**

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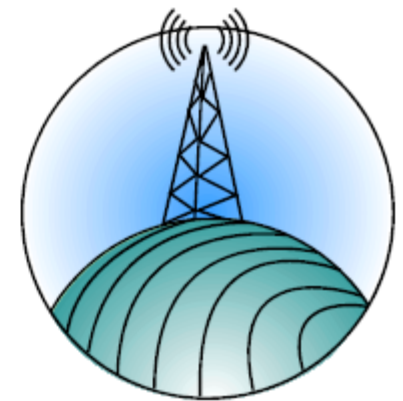
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Scientifically Planning a Station

There are three elements needed to plan an HF station *scientifically*:

- The range of elevation angles needed.
- Antenna performance parameters.
- The effects of local terrain.





What Angles Do You Need?

The elevation-angle files from *The ARRL Antenna Book* contain statistical averages over the entire 11-year solar cycle -- for all months of the year and for all hours of the day.



Sample - Boston To Europe

Elev	80m	40m	30m	20m	17m	15m	12m	10m
1	3.6	5.5	4.4	2.5	2.7	3.5	4.7	5.1
2	3.7	3.1	5.2	3	2.9	3.6	3.9	3.8
3	1.3	1.1	3.8	5.3	4.6	3.8	4.5	8
4	2.4	2.8	6.5	9.3	10.8	10.6	8.2	5.8
5	3.6	4.9	6.7	8.7	11	10.9	12	10.9
6	6.4	6.3	5.4	6.8	7	9.6	10.3	9.9
7	5.5	7.8	4.7	4.6	5.5	6.4	7.9	6
8	3.7	4.5	4	3.6	4.8	5.5	6.5	6.9
9	2.3	4.8	6.6	5.4	6.1	6.3	6.4	10.4
10	1.5	4	6.4	6.8	5.3	5	3.8	5.1
11	2.5	4	6.8	7.4	6.5	5	4.9	4.6
12	4.2	4.4	5.2	5.4	5.9	5.5	4.7	5.8
13	6.3	5.1	3.8	4.6	4.1	3.9	3.6	2.7
14	4.9	3.8	3.6	3.2	3.4	3.5	3.9	4
15	3.5	4.4	2.9	3.1	2.2	2.5	1.7	1.6
16	3.1	5.2	3.7	3.6	3.2	2	2.9	2
17	4.1	4.3	3.2	3.1	2.4	2.4	1.8	0.7
18	4.3	2.9	2.2	2.6	2.8	2.1	2.4	2.2
19	4.6	3	2.3	1.8	1.4	1.3	0.7	0.4
20	4.9	3.1	2.2	1.6	1.8	2	2	2.4
21	4.3	2.8	2.6	1.5	0.7	0.8	1.2	0.4
22	4.3	2.5	2.4	1.8	1	1.1	1.1	1.1
23	3.5	2.1	1.7	1.2	0.6	0.4	0.1	0
24	2.5	2	1.1	0.9	0.8	0.3	0.3	0
25	2.3	1.3	0.7	0.7	0.5	0.2	0.1	0
26	2.7	1.1	0.6	0.5	0.6	0.6	0.1	0
27	1.9	0.5	0.4	0.2	0.2	0.2	0.2	0
28	0.8	0.6	0.3	0.2	0.3	0.4	0	0
29	0.5	0.4	0.2	0.1	0.2	0.3	0	0
30	0.2	0.4	0.2	0.1	0.3	0.1	0	0

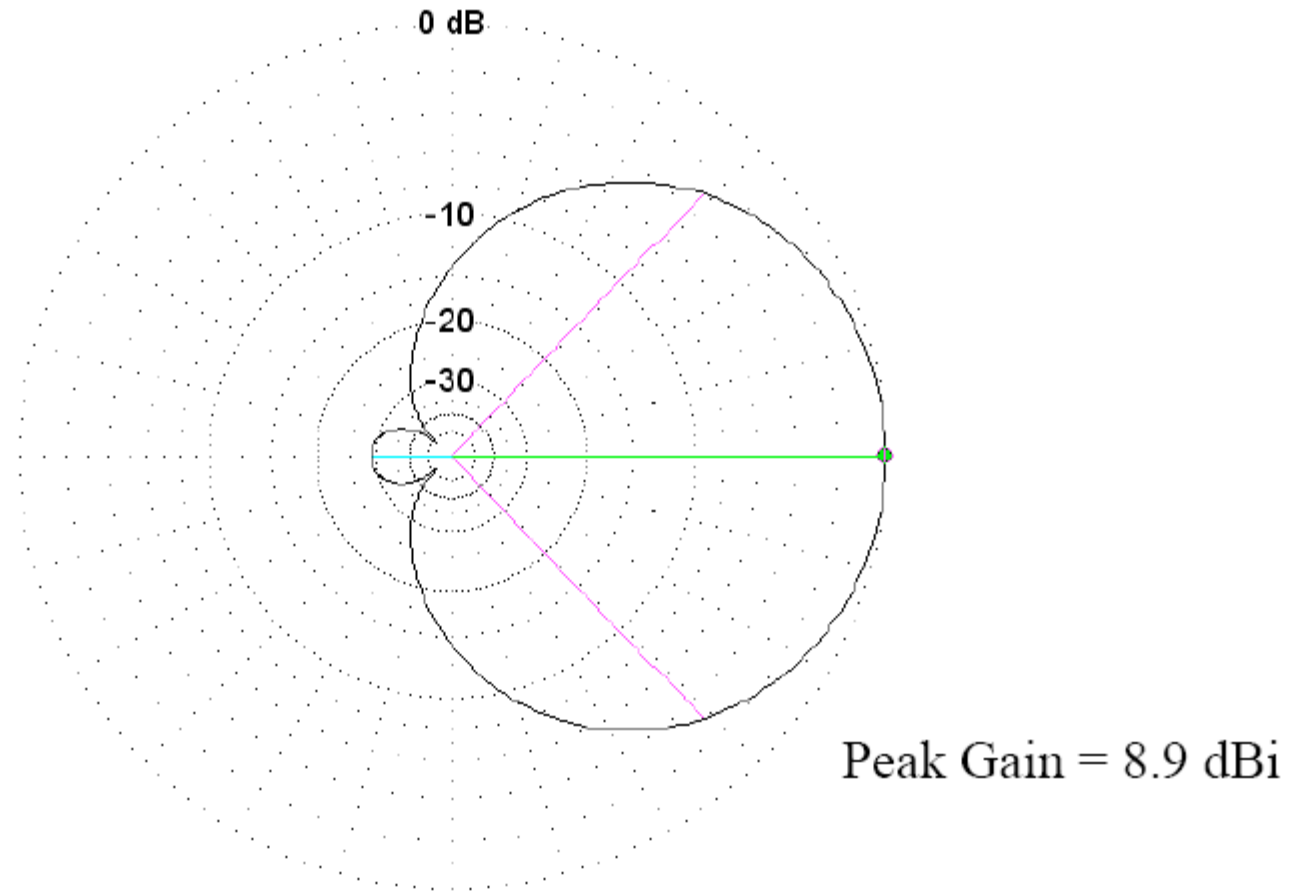


The *HFTA* Program

- *HFTA* stands for “High Frequency Terrain Assessment.” It is a full Windows program.
- *HFTA* traces the path of rays over 2D terrain, taking into account reflections and diffractions.
- The display of elevation angles needed are integrated into *HFTA*.
- *HFTA* is bundled with the 20th Edition of *The ARRL Antenna Book*.



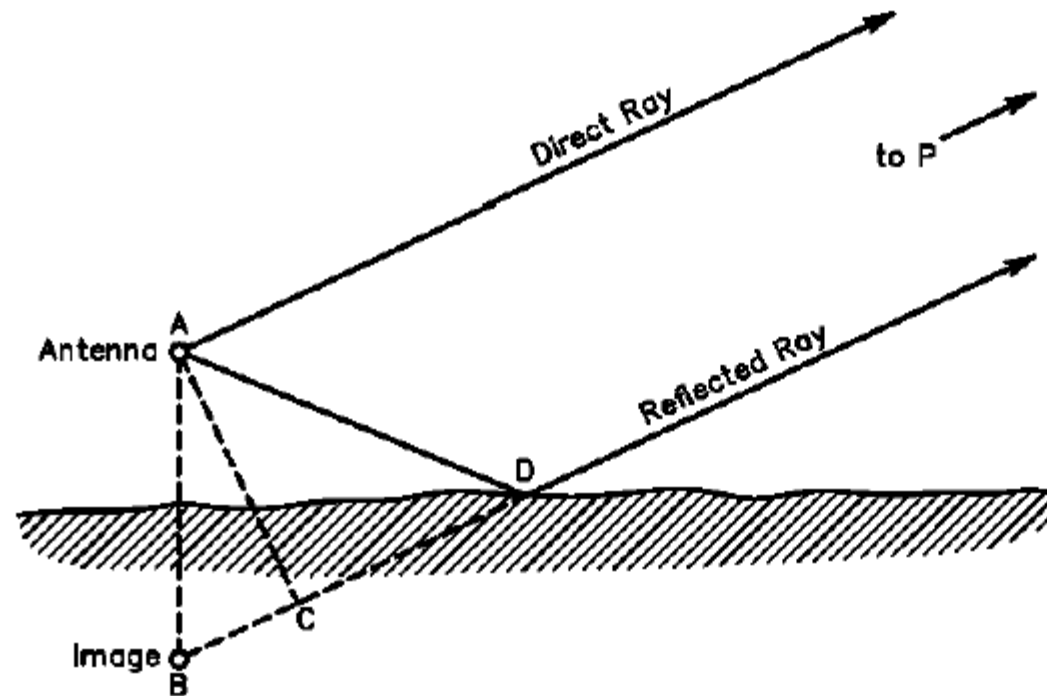
Gain in Free Space



The -3 dB H-Plane (Elevation-Plane) beamwidth is 92.4° for a 5-element 10-meter Yagi in free space.



Gain Over Ground

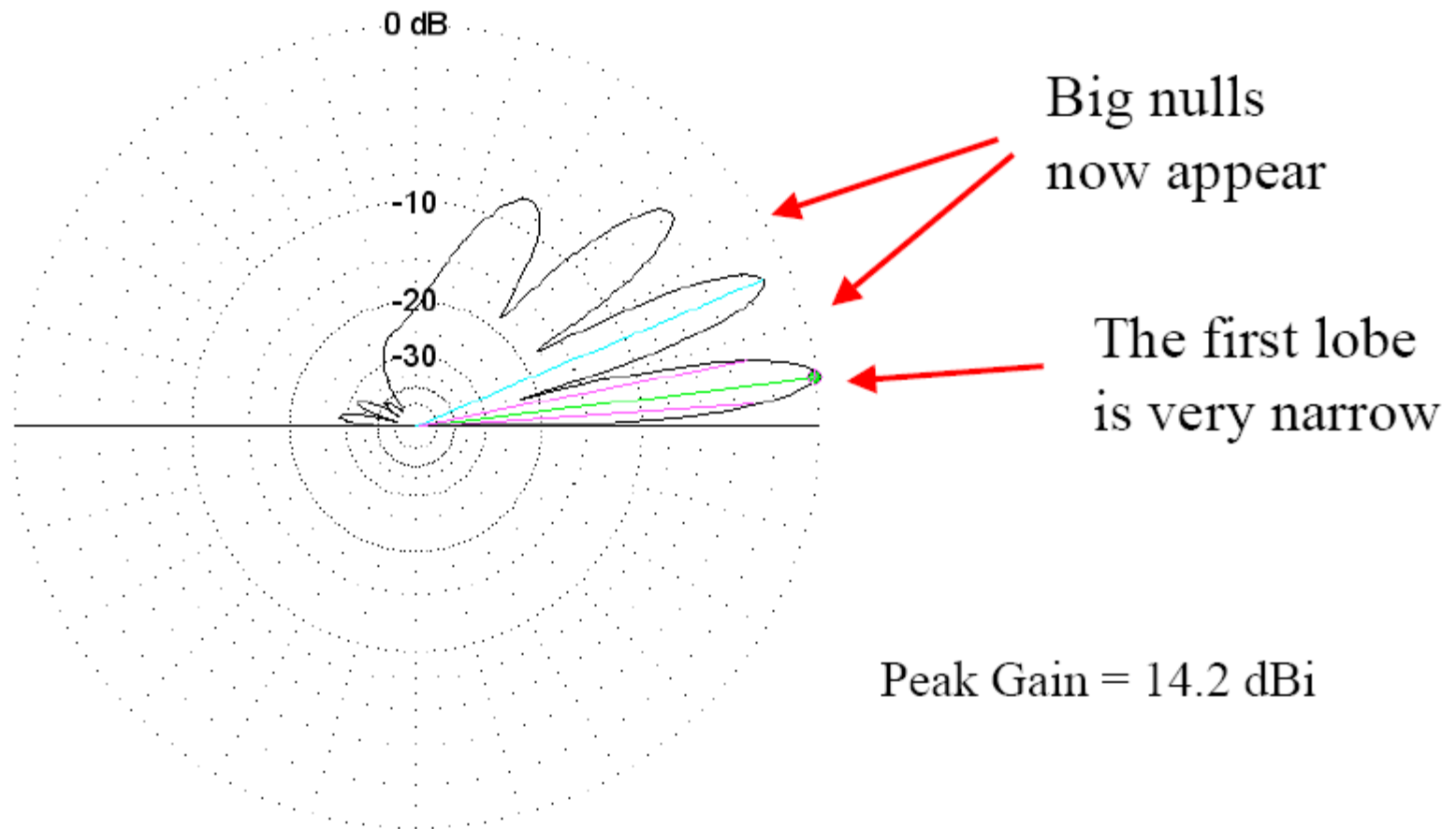


Reflections,
using theory of
images.

The presence of ground *profoundly* modifies the elevation pattern of any antenna compared to free space, because of vector addition of the reflected and direct rays, which travel different paths.



Gain & Pattern Over Ground



The -3 dB beamwidth is now only 8.3° for the same 5-element 10-meter Yagi mounted 66' (2λ) above average ground.

Sample .PRO File - K1ZO To Europe

Distance	Elevation
0	147.2
30	146.48
60	145.71
90	146.45
120	148.56
150	149.5
180	150.13
210	150.75
240	151.74
270	152.12
300	153.24
330	153.59
360	154.61
390	155.06
420	155.18
450	156.94
480	161.51
510	163.96
540	163.39
570	162.96
600	160.5
630	159.4
660	159.11
690	160.47
720	161.4
750	162.18
780	165.3
810	167.37



Getting Terrain Data for *HFTA*

- From paper topo maps -- excruciatingly painful!
- “Seamless” USGS NED (National Elevation Dataset) database -- easy to use.
- DEM (Digital Elevation Model) data -- may require “merging” of several 7.5-minute maps to cover required area. Merging can be a pain.

(The *HFTA* manual details how to access either electronic form of terrain data.)