2m ARDF behaviour (+ simulation with Radio Mobile)

ON4CHE

The 2m ARDF (Amateur Radio Direction Finding) was once again proven to be a speciality as demonstrated by the 1997 World Championship competition in Sankt Englemar, 1997, where many of the world's top runners missed the time limit of the 2m discipline.

This article will handle the specialities of the 2m direction finding during ARDF competitions by looking specifically at the following:

- Classification of the 2m reflections.
- Properties and recognition of 2m reflections during ARDF competitions together with the measurements that can be taken against the reflections.
- The special case of having a transmitter behind the top of a hill.
- Simulation with Radio Mobile of two use cases.

Depending on the origin of the reflection, we recognise 2 types of 2m reflections:

- Local reflections.
- Geographical reflections.

Both often exist in the neighbourhood of water e.g. the environment is wet after rainfall.

Local reflections are caused by objects in the neighbourhood (ranging from a few meters to a hundred meters). They typically are appearing on:

- Edges of tree lines or perimeters of wooded areas
- Man made objects like houses, cars, palisades, ...
- Waterfronts
- Dunes,
- ...

In the all of the above cases the boundaries must be at the very least several meters in width.

You can recognise them by the fast changing of direction during running. It's easier to recognise the fast changing direction by using a 4 element Yagi, with a small opening angle, as with a HB9CV with a large opening angle.

These reflections also typically appear when we are measuring the direction standing in front of an object which can cause the reflection.

Geographical reflections are caused by objects far away (ranging from a few hundred meters to several kilometres). The objects are typically a few hundreds meters in width and can be broad categorised as follows:

- Dunes.
- Hills
- Mount Borders.
- ...

These reflections mainly occur in hilly areas. The signal can come out of different directions, but this is not necessary. It's possible that the reflected signal is much stronger than the origin signal.

The signal, coming out of the reflection direction, is changing slowly during running, making it much more difficult to recognise them. A further point to consider is the fact that going to another valley can also typically change the reflected direction.

The geographical reflection will come from everywhere in a valley. It's impossible to measure the transmitted direction in this situation. Going to the top of the hill is the only chance to cope with this problem.

Geographical reflections are the type of reflections we will simulate with Radio Mobile.

The signal strength going up the hill in case the transmitter is behind the top of the hill, is not a reflection, but also interesting phenomena we can simulate with Radio Mobile.

As the fox hunter is shielded by the hill, the signal will original decrease and finally increase. Only way to cope with this problem is to trust your original plan to go over the hill.

We will simulate with Radio Mobile 2 cases:

- Reflection on a hill, far away of the fox hunter.
- Transmitter behind the top of a hill.

The simulations are done with next boundary conditions:

- Receiver with 1µV sensitivity, horizontal polarized antenna 1 meter above the ground.
- Transmitter with 1W power, horizontal polarized antenna 2 meter above the ground.
- Maritime temperature over land (wet area with good reflection conditions).
- Propagation mode: "two-rays" for line-of-sight with interference.

Case 1: Reflection on background hills.

The transmitter is placed on a high hill in the western part of the area. The receiver is more or less in the middle of the area at the east side of on a small hill. He is a little bit shielded by this hill. The receiver has very good view on the high hills at the east side.

The easter hills will work as a reflector. Because the receiver has visual a better view towards the reflectors as towards the source, he will probably get a better signal from the reflections.

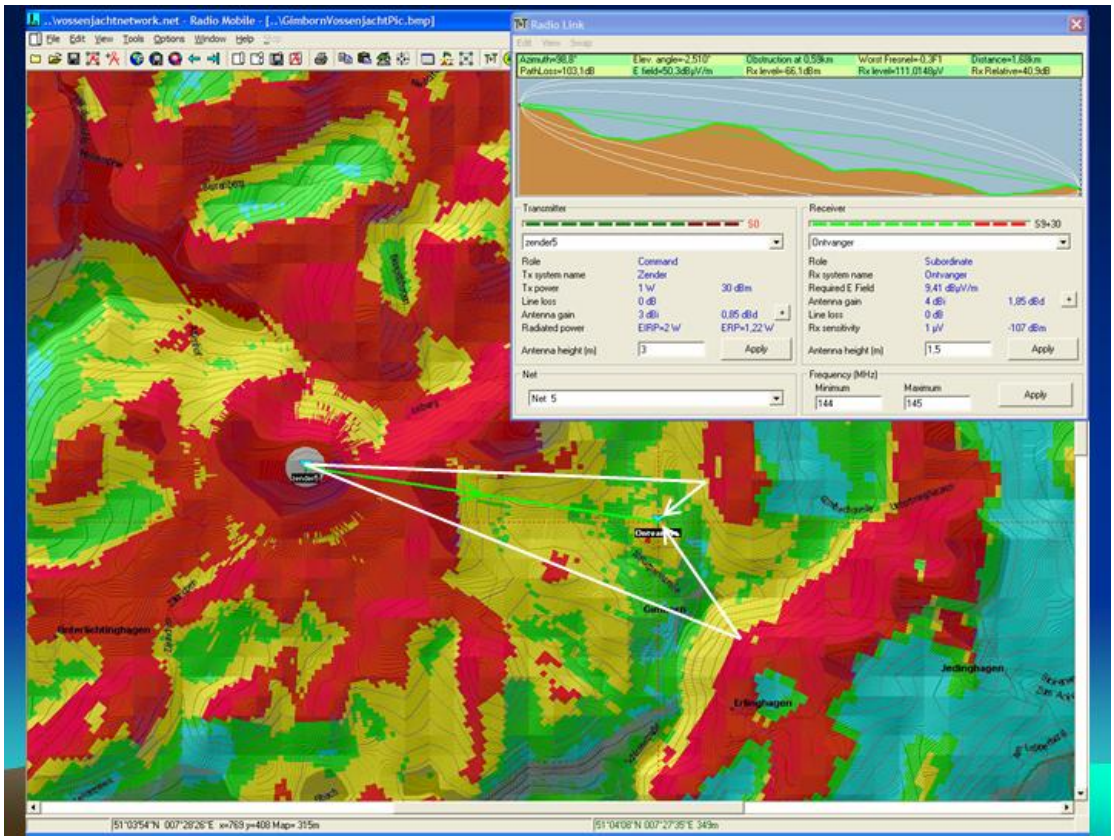

Figure 1: The receiver measure the signal form 3 sides.

Case 2: Transmitter behind the hill.

Between the competitor and the transmitter is a hill. This is shielding the signal from the fox. The foxhunter has first to go through the valley, climbing on the hill and running over the top, he will find the transmitter.

At the moment, he start climbing the hill, he will be very good shielded by the hill and his signal will decrease. At the moment he continue his path, the signal will increase again.

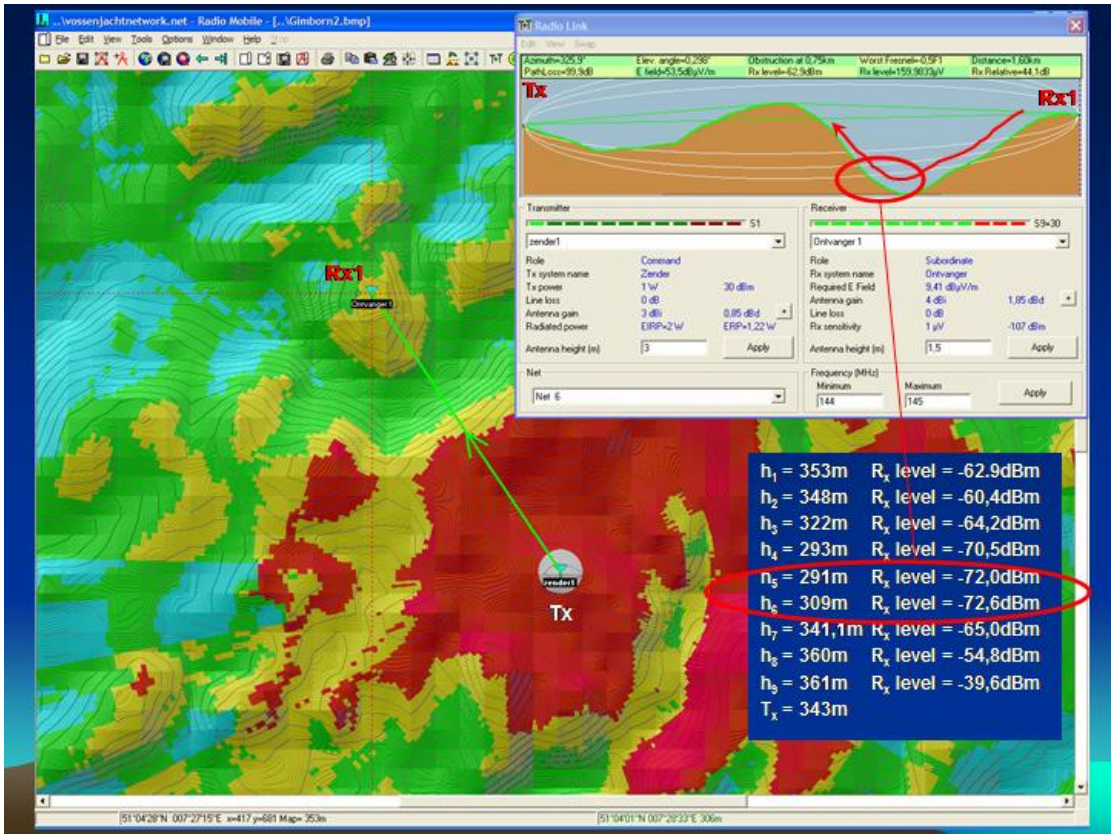

Figure 2: Despite the fox hunter is going uphill from Rx to Tx, the signal decrease.

Summary:

We can classify the challenges with the 2m reflections in two high level categories:

- Local reflections are not predictable but are easy to recognise as they change very fast their direction during running.
- Geographical reflections are more difficult to recognise as they change very slowly their direction. These reflections are more predictable.

Radio Mobile is suitable to simulate the geographical reflections together with the special case of a transmitter hidden by a hill.

With the use of Radio Mobile, it's possible to optimise 2m ARDF trainings to focus on geographical reflection exercises.

Good luck in your next competition!

73s, Kurt
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