Direction Finding

Introduction to

DF Tools and Techniques

Santa Clara County ARES®/RACES

Last Updated 2011-Jun-12

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Learning Objectives

By the end of this class, you should be able to:

- Explain what DF'ing is all about
- Know how to get started DF'ing
  - How to prepare for "the hunt" or a "search and locate" exercise
  - Know how to find a local T-Hunt
- Know what techniques work for various situations
- Better handling of "stuck microphone" situations
- Understand the role of the Amateur Auxiliary and the FCC
- Escalating issue to the OOC
- Know where to go for more information
- See what other people use for DF'ing

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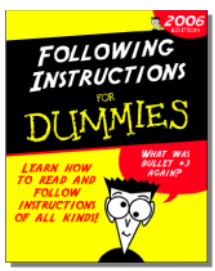
Housekeeping

- Pen/pencil & paper
- Cell phones & pagers
- Side conversations
- Avoid spurious transmissions, hidden transmitters, and jamming the instructor….
- Questions
- Breaks
- Restrooms
- In case of emergency



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Agenda

- What is DF'ing?
- What's a T-Hunt?
- Issues with DF'ing
- DF Tools, Techniques, and Demonstrations
- Advanced Techniques
- ARRL Amateur Auxiliary
- Escalating jamming problems in SCV
- Helping out the SCV OOC
- Links

What is Direction Finding?

- Simply put: locating a source of a signal transmission
- Why would you want to do that?
- Sometimes signals need to be found and the techniques are common:
  - (Un)Intentional Jamming
    - Bad behavior
    - Stuck microphone/transmitter
  - Interference from spurious noise
    - Computers, network hubs, electric fences, broadcast harmonics, BPL

What is Direction Finding?

- Emergency Locator Transmitter (ELT)
- Search and Rescue (SAR), Search and Locate
- Locate "downed" equipment a
  - Model airplanes / rockets
  - Weather balloons or similar
- Wildlife tracking
- It's FUN!
  - Monthly T-Hunts
  - Contesting
- Any other reason you can think of?

DF'ing is an Art

- Takes practice and patience
- Getting to know the equipment
  - Different benefits and quirks
- Signals are usually not well-behaved
  - Can change in time, location, quality, etc.
- Environment
  - E.g. open field vs. city with multi-path (reflections)
- T-hunts are a great way to build practice

Typical Planned T-Hunt

- People show up a starting point
- Fox starts some distance away
- Everyone pulls out a yagi to get initial bearing
- Travel some distance, take another bearing
- Triangulate, get closer
- Pull out HT
- Find Fox
- Go get pizza

How to find a T-Hunt?

- Local SF Bay T-Hunts
  - Northern California Transmitter Hunting Group
    http://www.qsl.net/sfthunt/index.html
    "Fremont T-Hunt"
- NOTE: Regularly scheduled T-Hunt activities tend to come and go following levels of participation
  - Nudge: motivated people/groups could help restart or hold their own

Issues with DF'ing – Plan Ahead

- Finding versus just getting a good bearing
- How far away is the transmitter?
- Is the source moving?
- Terrain?
- Buildings, multi-path?
- Is the signal continuous?
- Do you need to hear your equipment?
- Beams and crowds don't mix

Techniques / Equipment

Passive:

- Handheld
  - With or without antenna
  - Body Fade, with and with out a tube
- Loop Antenna
- Directional Antenna
- Attenuators

Techniques / Equipment

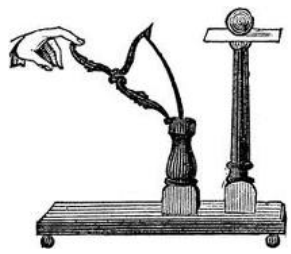
Active:

- Signal Tracker
- Hand-held Time of Arrival
- Mobile Doppler

Hand-Held with/without antenna

- Pros
  - Everyone likely to have one
  - Body shielding technique can be quite effective
  - Signal strength indicator
  - Without antenna, excellent proximity detector
- Cons
  - Not good for distant or too-strong signals (on strong signals this is due to the S meter range)
  - Digital squelch may not be fine grained enough

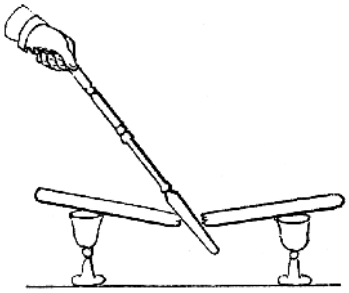
DEMONSTRATION



Loop Antenna

- Pros
  - Will work with any handheld
  - Excellent directivity
  - Working proximity increased with attenuator
- Cons
  - Not good for distant or too-strong signals (on strong signals this is due to the S meter range)

DEMONSTRATION



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Directional Antenna Beams and Yagi's

- Pros
  - Will work with any handheld or for home bearings
  - Best for weak or distant signals
  - Directivity directly related to front-to-back ratio
  - Working proximity increased with attenuator
  - Directionality in preference to impedance/frequency
- Cons
  - Not good for too strong a signal (on strong signals this is due to the S meter range)
  - Hazardous around crowds

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DEMONSTRATION

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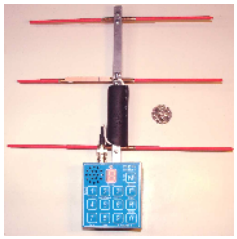
Active Tracker

- Pros
  - No HT or other receiver
  - Works well with loop and beam antennas
  - Works well with distant, strong, and close sources
  - Self adjusting signal strength meter
- Cons
  - 2m and 440m only
  - Costs money



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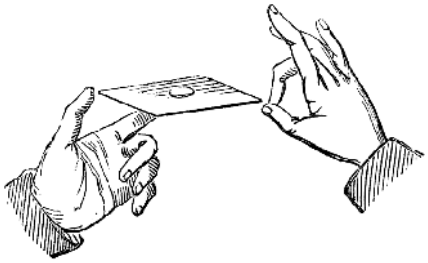

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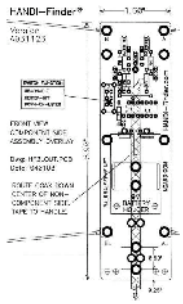
Handi-Finder Time of Arrival

- Pros
  - Works with any receiver
  - Reasonable cost
- Cons
  - Build from kit, obtain antenna parts, handle, etc.
  - May not work for distant signals



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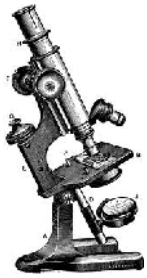

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Break time

Balancing Equipment vs. Fox

- Rubber duck not good for “distant” signals
  - Suggests a gain antenna
- Beams might get overwhelmed “close” to source
  - Suggests an attenuator or active method
- Antenna aiming slow compared to random “kerchunking” or intermittent transmissions
  - Mobile doppler works well

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What to bring for a T-Hunt?

- Handheld (not all T-Hunts are 2m….)
- Directional antennal
- Optional
  - Attenuator
  - Body shield tube
  - Map
  - Compass
  - Straight-edge

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Advanced Techniques

- Mobile Doppler
- iPhone tools
  - Personal bearing assistant
- Computer Assisted Mapping
  - Placement, bearings, triangulation
- Group coordination
  - Alternative radio channels (e.g. 220MHz)
  - Group phone conferencing

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Equipment Safety Reminder

- DF'ing is a receive-only operation
  - Many antenna types are receive only
  - Transmitting through the antenna might damage your radio and/or the antenna
  - Using any transmit locks are a good idea

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Stuck Microphone Situations

- You are at an event and a “stuck microphone” situation takes out the main tactical channel
- What do you do?
  - Switch to secondary (net control may direct)
  - See the ICS 205, be prepared!
- You now know some DF techniques!!!
  - Take a bearing, report location and bearing

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Directional Bearings

- Two types of bearings
  - True North (map bearing, grids point north)
  - Magnetic North (compass bearing)
- Difference between the two is called:
  - Magnetic Declination
  - Varies from place to place over the Earth
- How to find it for your area
  - On line references
  - Aviation Maps

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True vs. Magnetic

- How to convert between the two
  - Find your local declination
  - “East is Least”
- Directly from compass
- From map, subtract 14.5 degrees
- Go study it:
  - http://www.magnetic-declination.com/
  - http://www.compassdude.com/compass-declination.shtml

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ARRL Amateur Auxil

- Group of over 700 volunteers
- Eyes and Ears for ARRL and FCC
  - "Official Observers" e.g. OO's
  - Advisory only, no authority!!!
  - Amateur<>Amateur
- Local Section OO Coordinator
  - Andy Korsak, kr6dd
- http://www.arrl.org/amateur-auxiliary

Escalating Jammer Problems

- Notify the repeater owner
- Notify the OOC
- Assist with taking any bearings, notes, times, etc. as needed
- Go on "the hunt", as organized
- Let the OOC call the shots
  - Avoid "taking action", contacting, etc.
  - Don't repeat the jammer's actions

How to help the OOC with Jammers

1. Being able report from home/field
   - Bearings
     - Steerable antenna (e.g. on a rotor)
   - Reception / power reports
2. Joining with others in hunts
   - Some experience in DF'ing

* Interested and able?
- Contact Mark Laubach k6fjc@arrl.net via email. A questionnaire will be sent back then passed on to Andy for his "processing"

Remember

- Above all else, your safety is number one!
- Having fun or "being on a mission" doesn't bend any laws in your favor
  - Obey all laws
  - Avoid being a vigilante or a stalker

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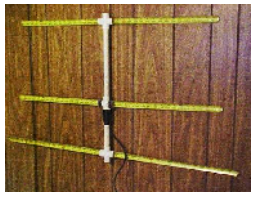
Notable Mention

- No ends to invention for a Ham with an idea
  - http://www.w8mrc.com/2009/12/18/radio-direction-finding-antenna-for-vhf/



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Links

- http://en.wikipedia.org/wiki/Transmitter_hunting
- http://foxhunt.rail.com/foxhunt/Home.html (iPhone application)
- http://www.handi-finder.com/ (hand held "doppler")
- http://www.foxhunt.com.au/ (VHF Sniffer MK4)
- http://www.arrowantennas.com (antennas, loops)
- http://www.homingin.com/ (RDF overview and resources)
- http://www.byonics.com/ (Kits for APRS, PocketFox)
- http://www.homingin.com/intlfox.html (overview International Fox Hunting)
- http://www.adeptco.com/adeptinstruments/ (UHF foxhunt xmitters)
- http://www.w9az.com/foxhunt_main.html (organized fox hunt contesting)
- http://www.seese.net/ron/tbox/tbox.htm (kit stuff)
- http://www.ardf-r2.org/equipment/ (ARDF IARU Region II info page)
- http://www.wb8wfk.com/equipment.html#tx (fox hunt xmitter example)
- http://www.ramseyelectronics.com/ (affordable doppler system)
- http://www.arrl.org/direction-finding (A Doppler Radio-Direction Finder Part 1 & 2)
- http://www.arrl.org/direction-finding (The Four-Way Dfer)

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