Pulse-Coding Techniques for Incoherent-Scatter Radar

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RAL

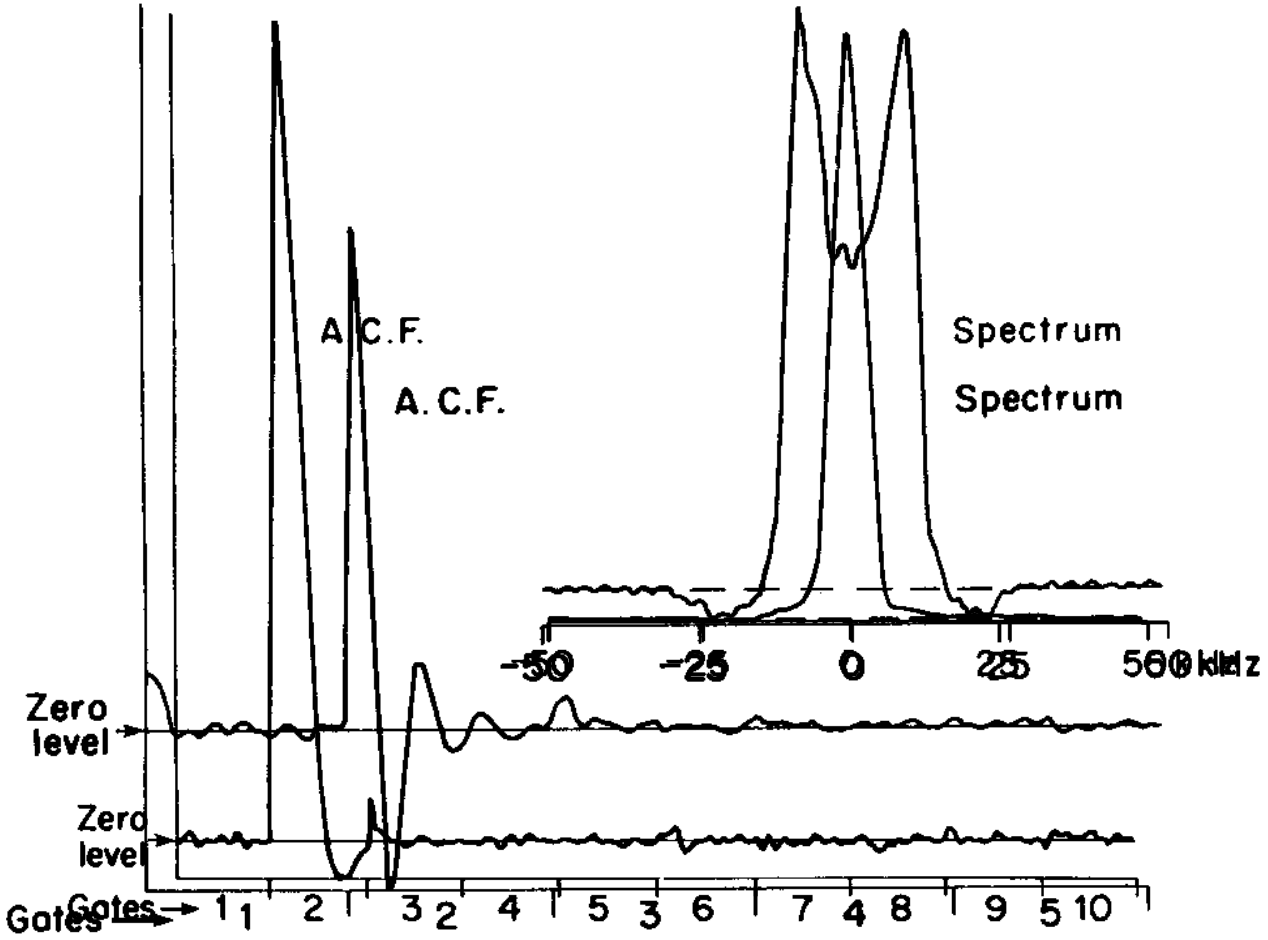
OVERVIEW OF TALK

- Constraints on I.S. measurements
- Long pulse
- Power profiles
- Pulse to Pulse
- Multipulse
- Barker Codes
- Complementary Codes
- Random Codes
- Alternating Codes

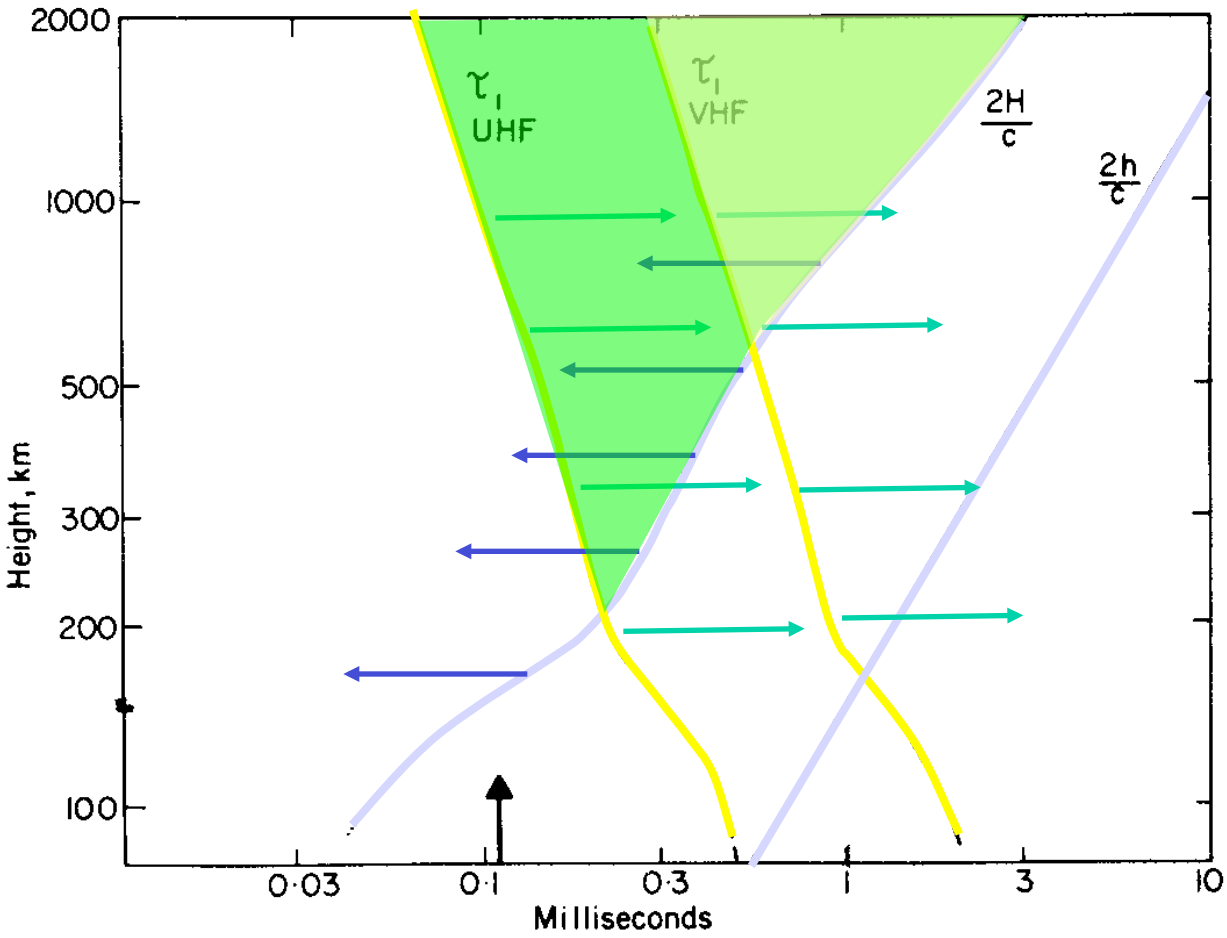
Constraints on I.S. Measurements

- Monostatic measurements cannot transmit and receive at the same time
- Height resolution < Scale Height
- Chosen pulse must give good SNR
- Lag spacing small enough to define ACF accurately
- ACF sampled to correct length
- Sample spacing matched to filter width
- Filter width appropriate to spectrum

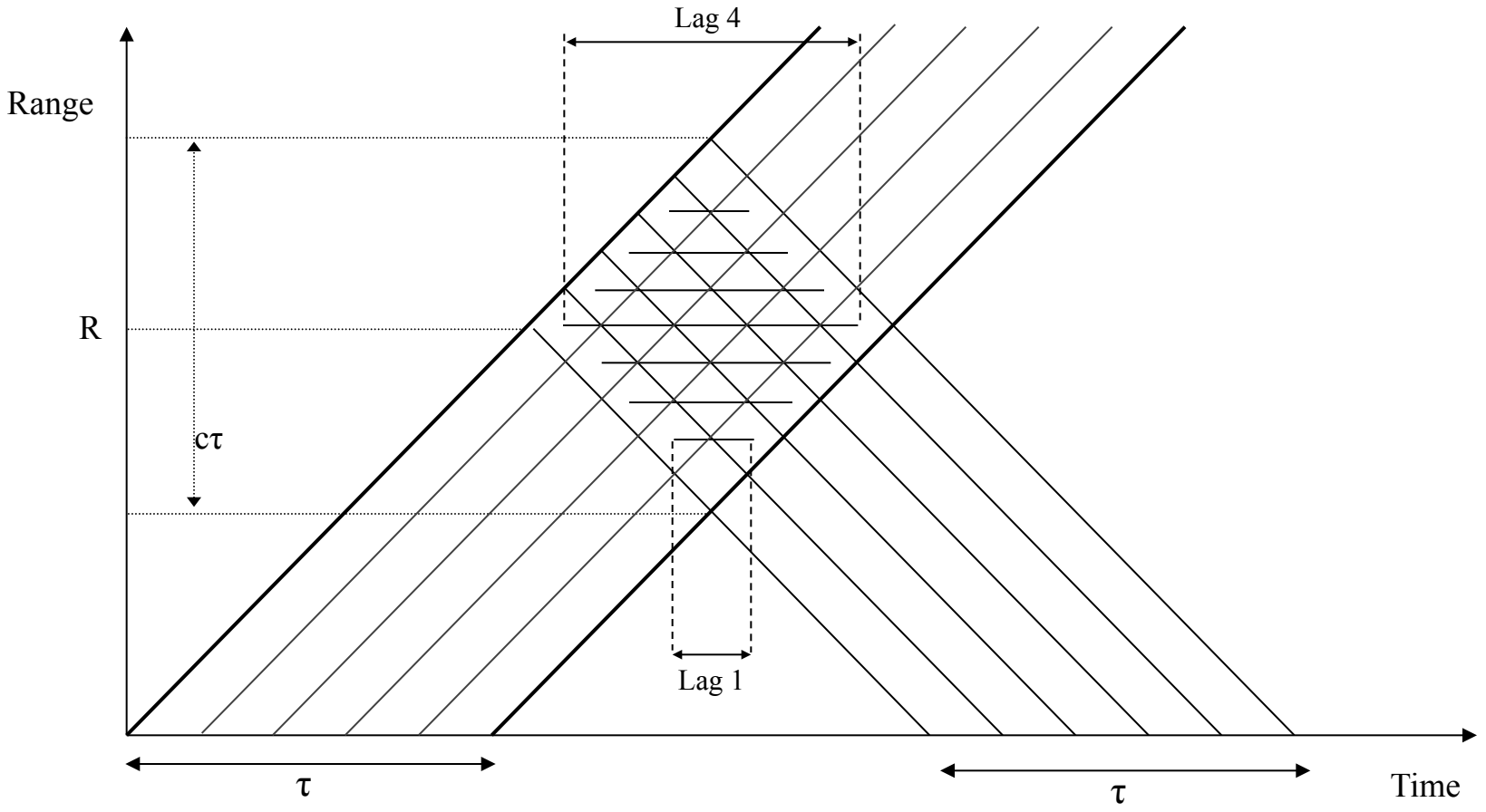
Constraints on Measurements



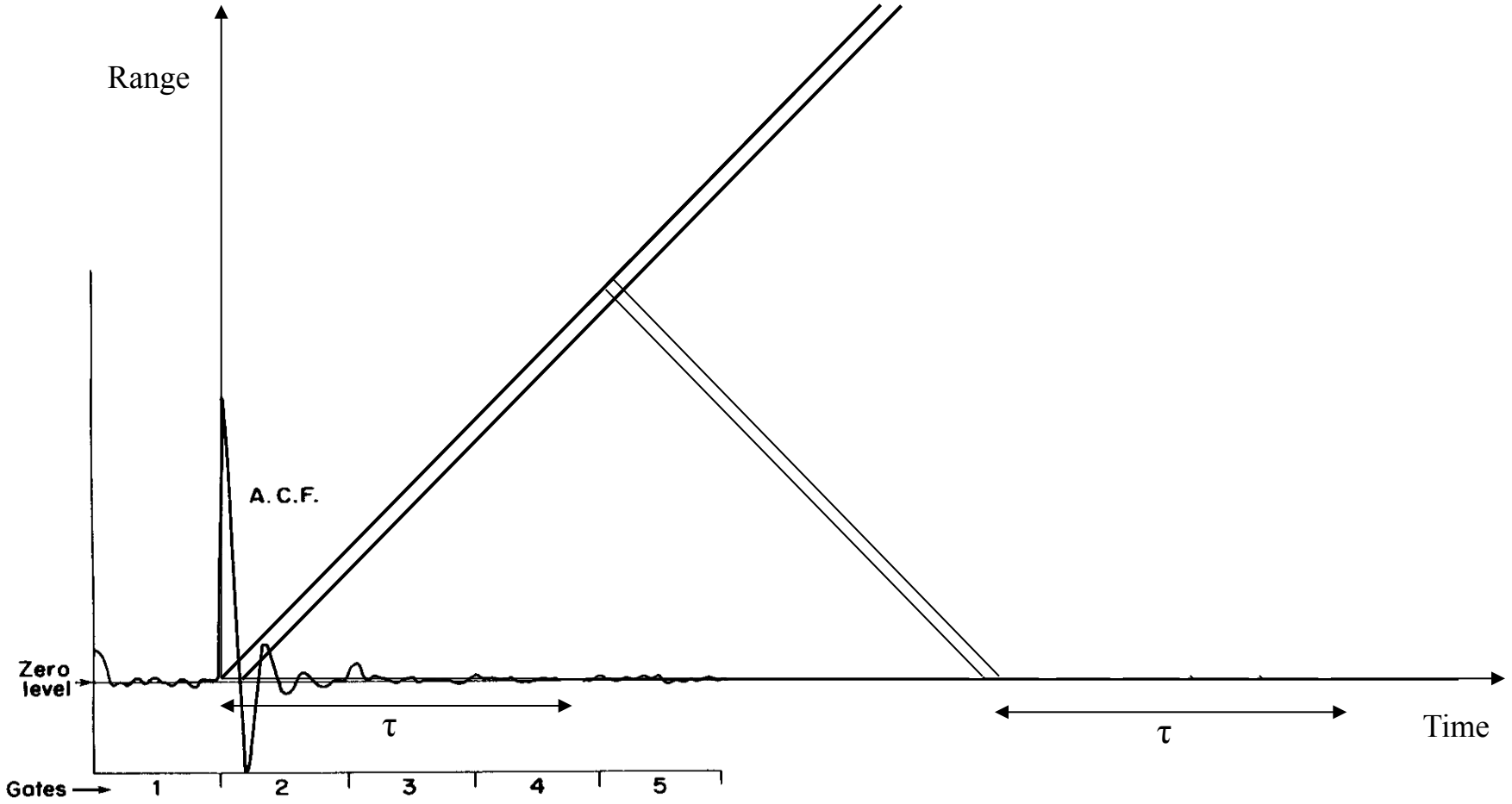
Farley Diagram



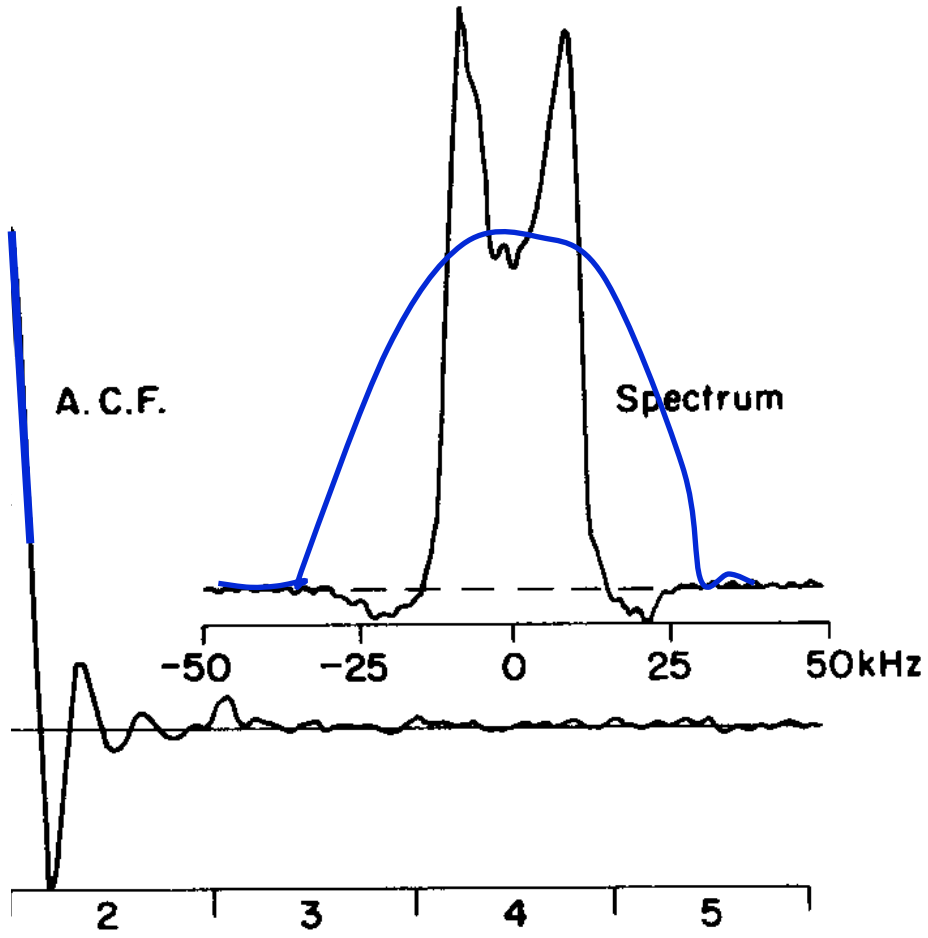
Range-Time diagram for a single pulse



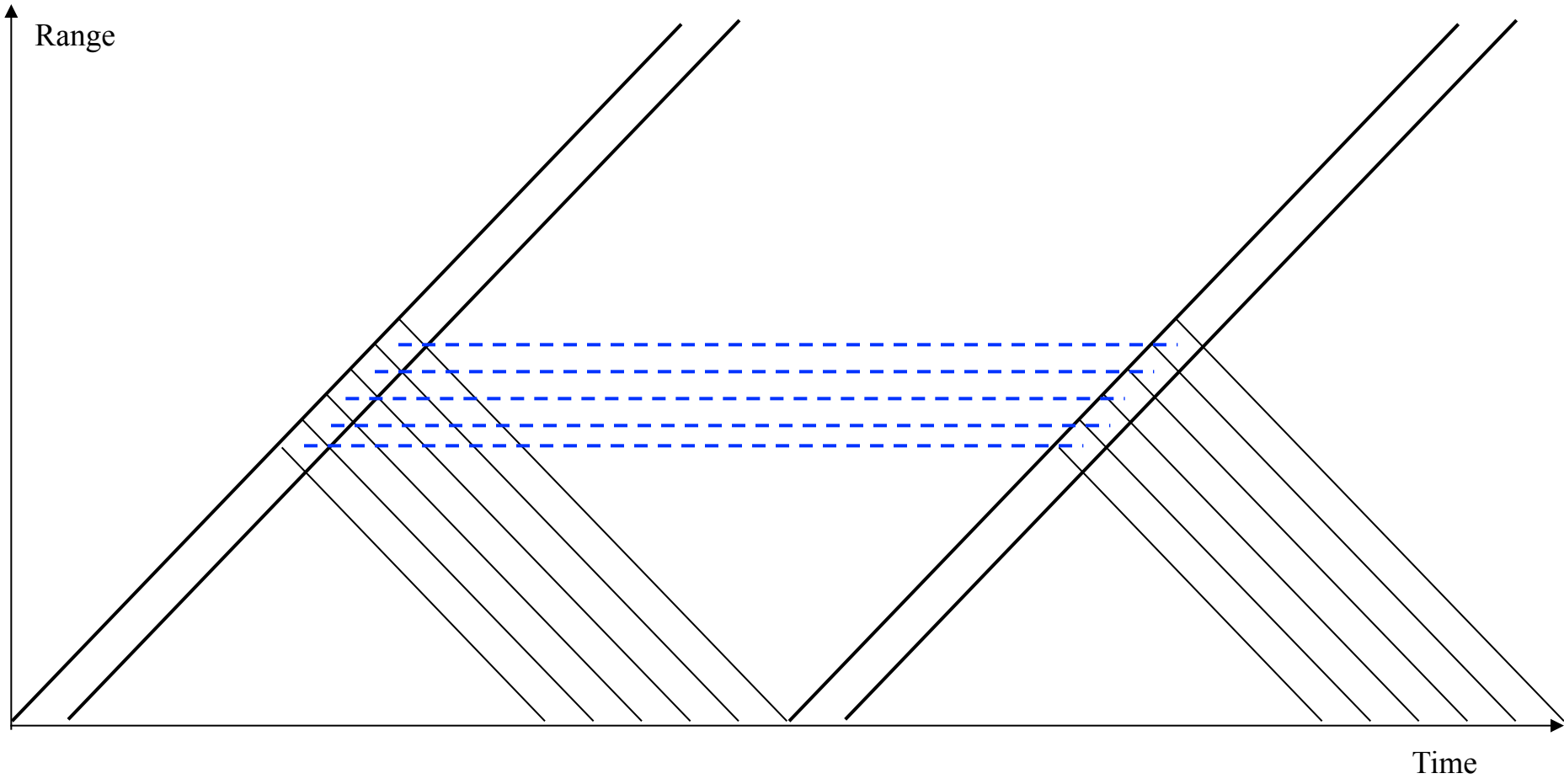
The Power Profile



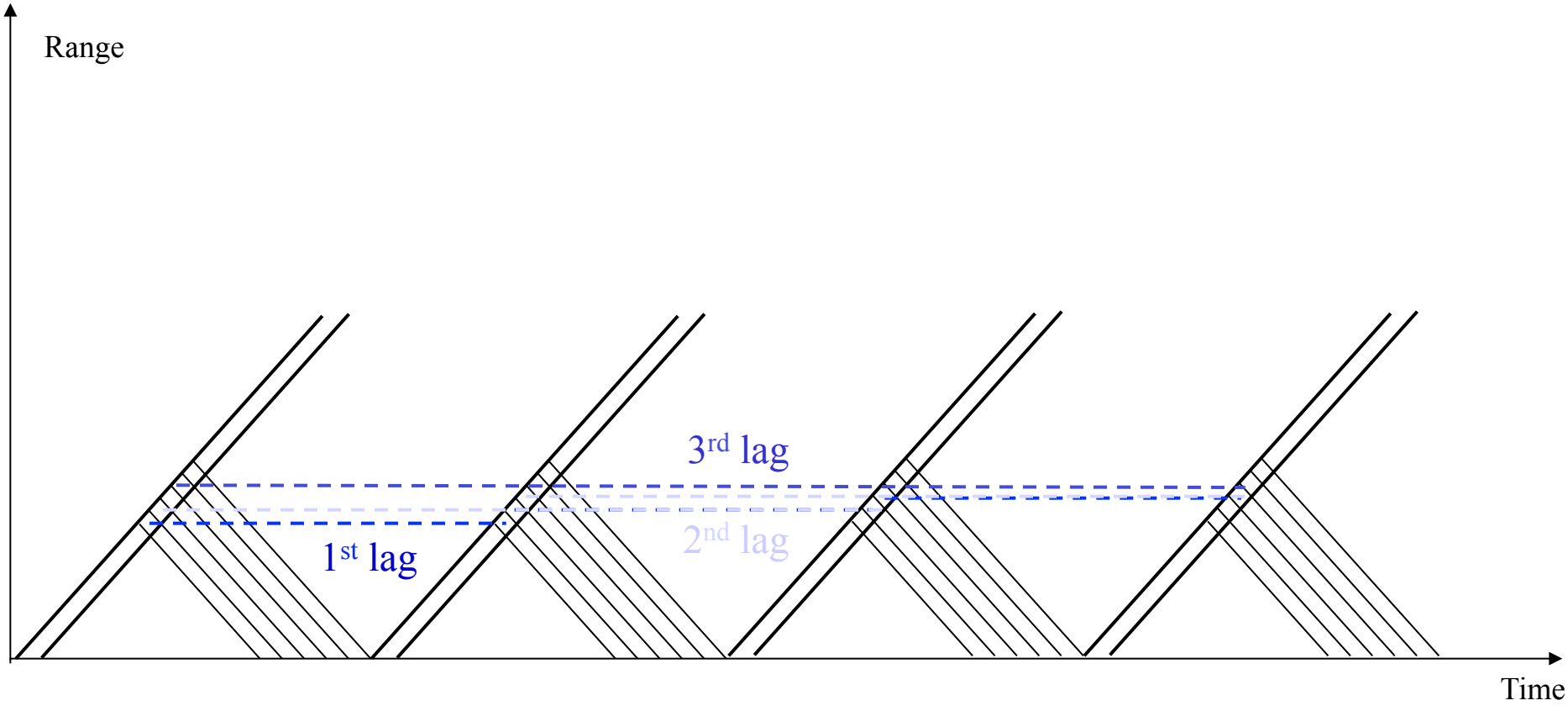
The Power Profile



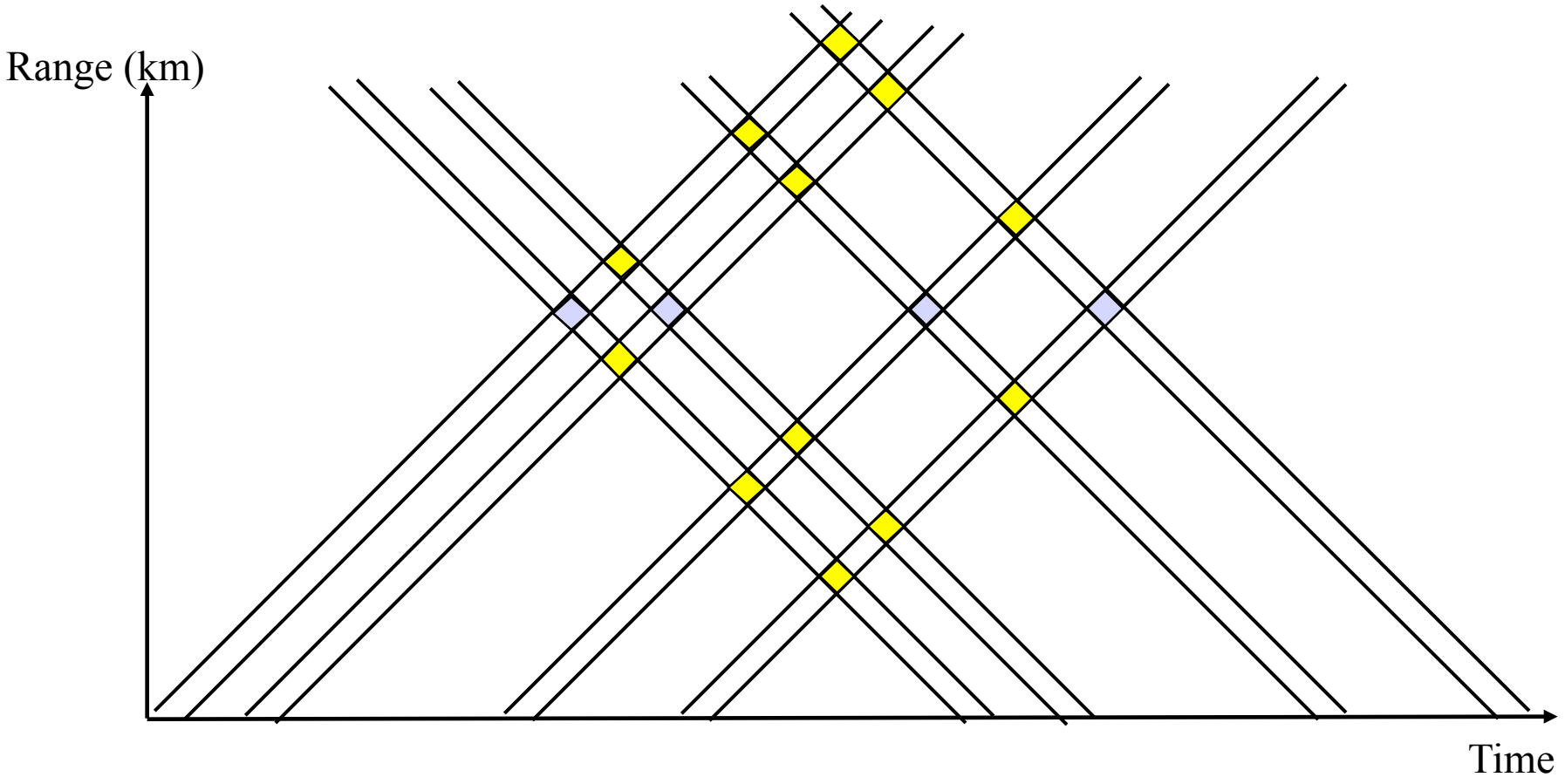
Pulse-to-Pulse



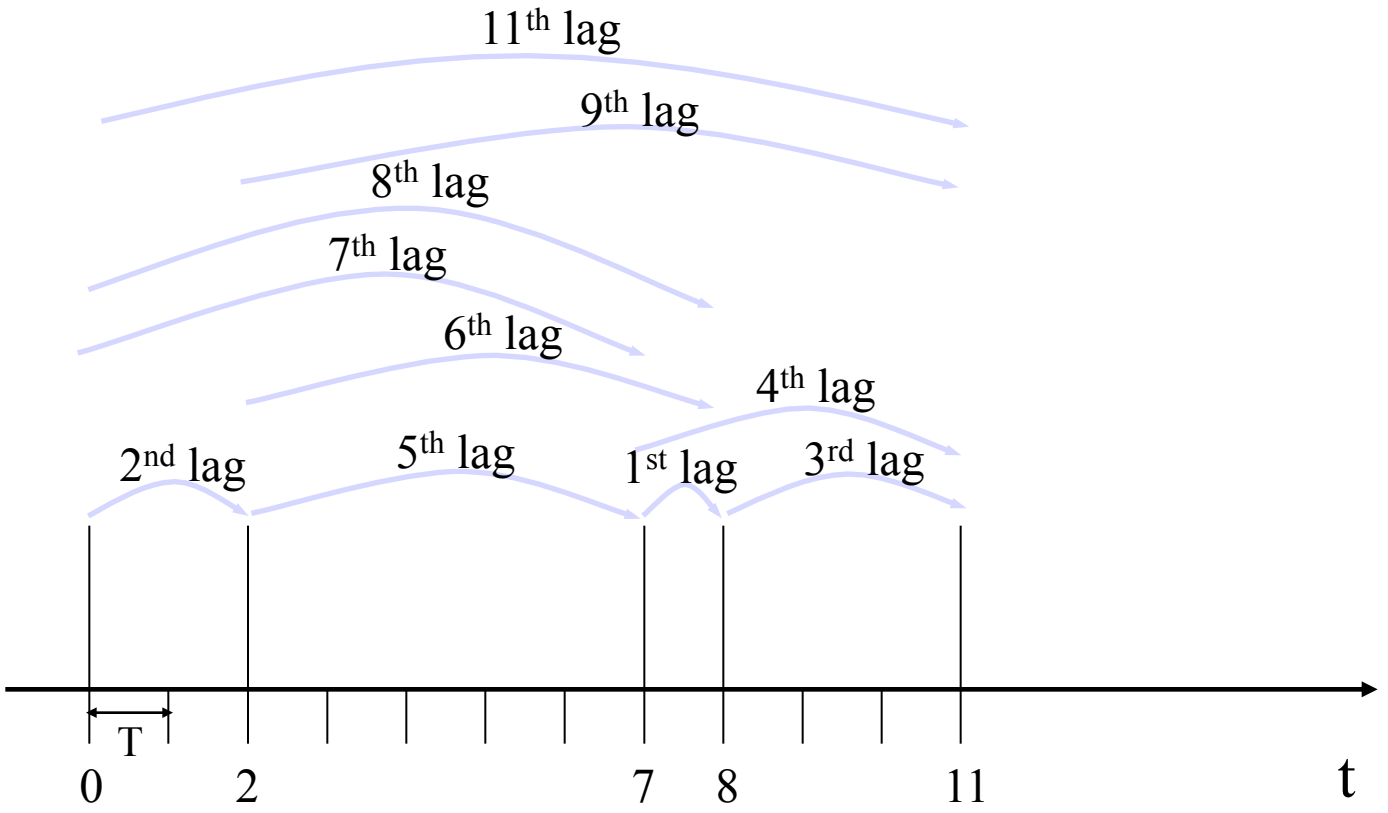
Pulse-to-Pulse



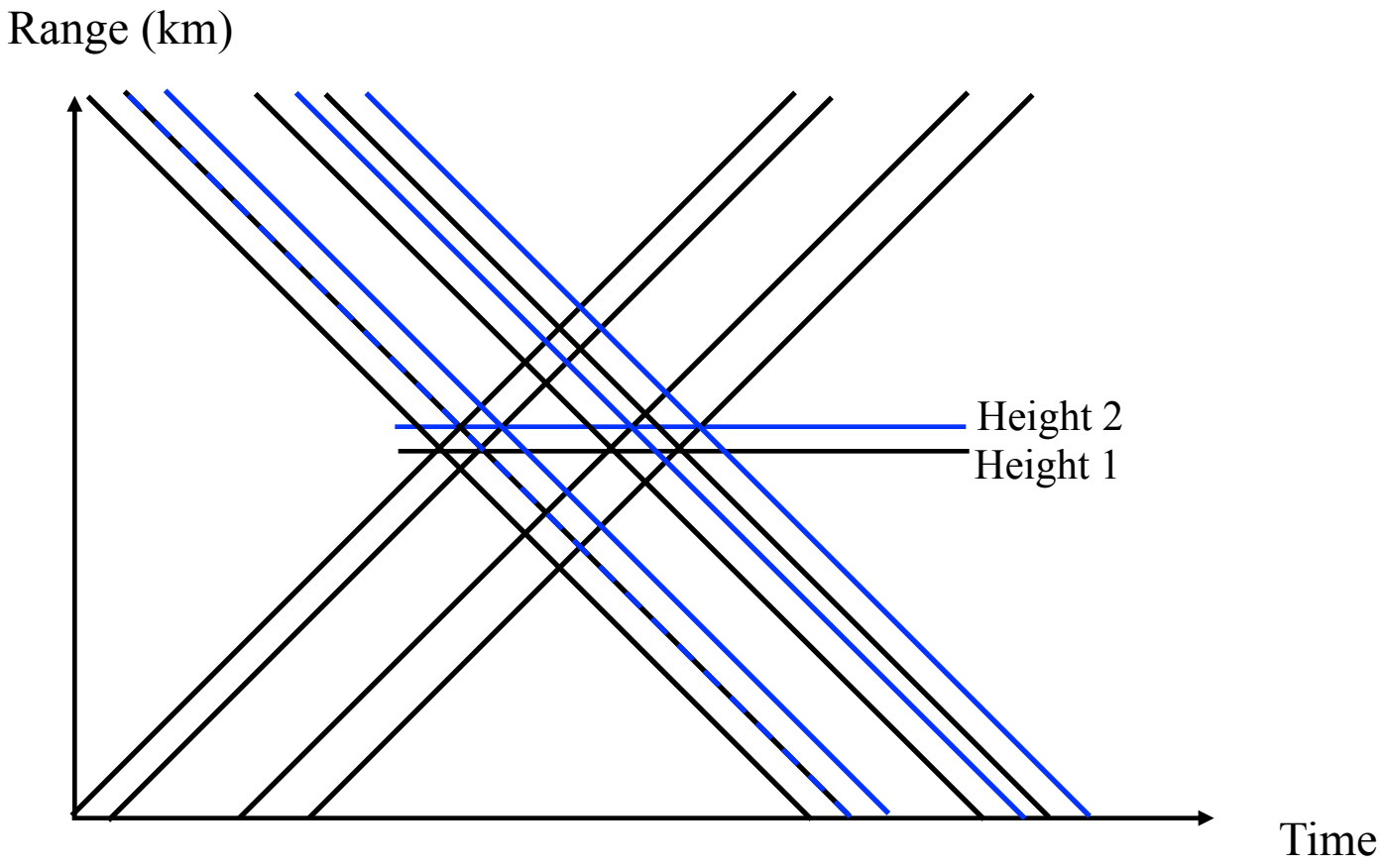
Multipulse



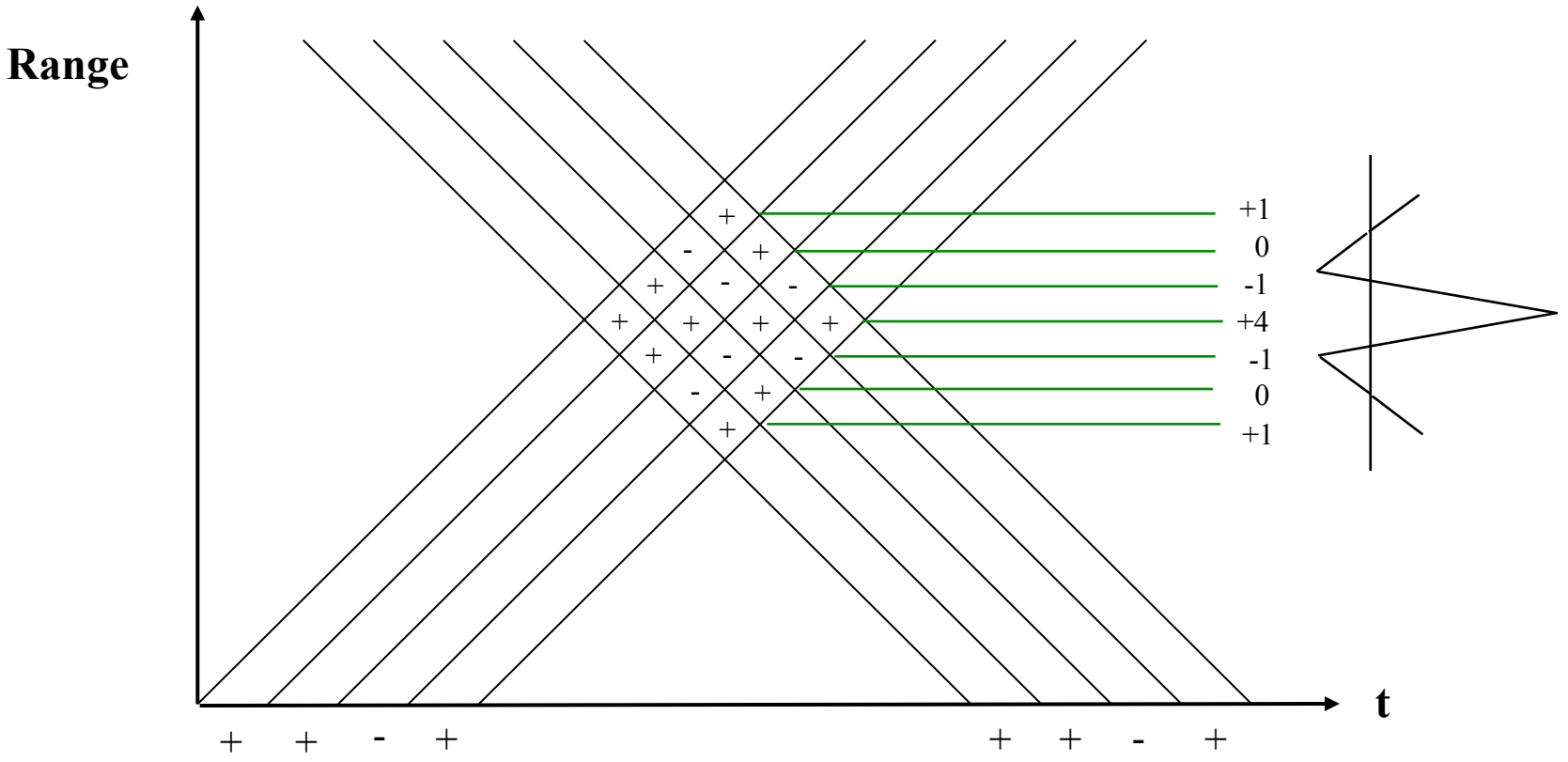
5-Pulse Multipulse



Multipulse Codes



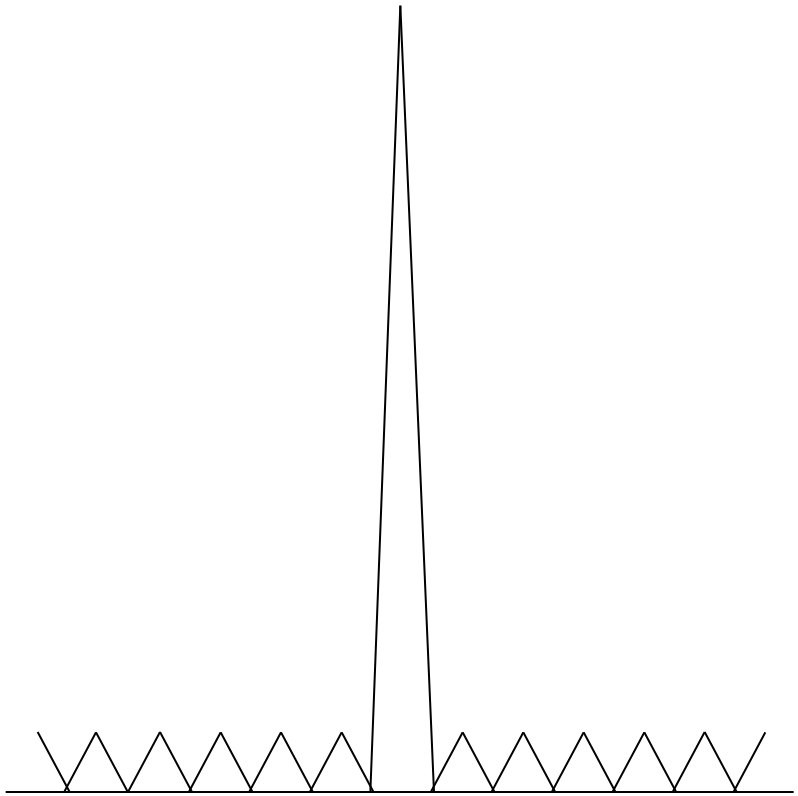
Barker Codes



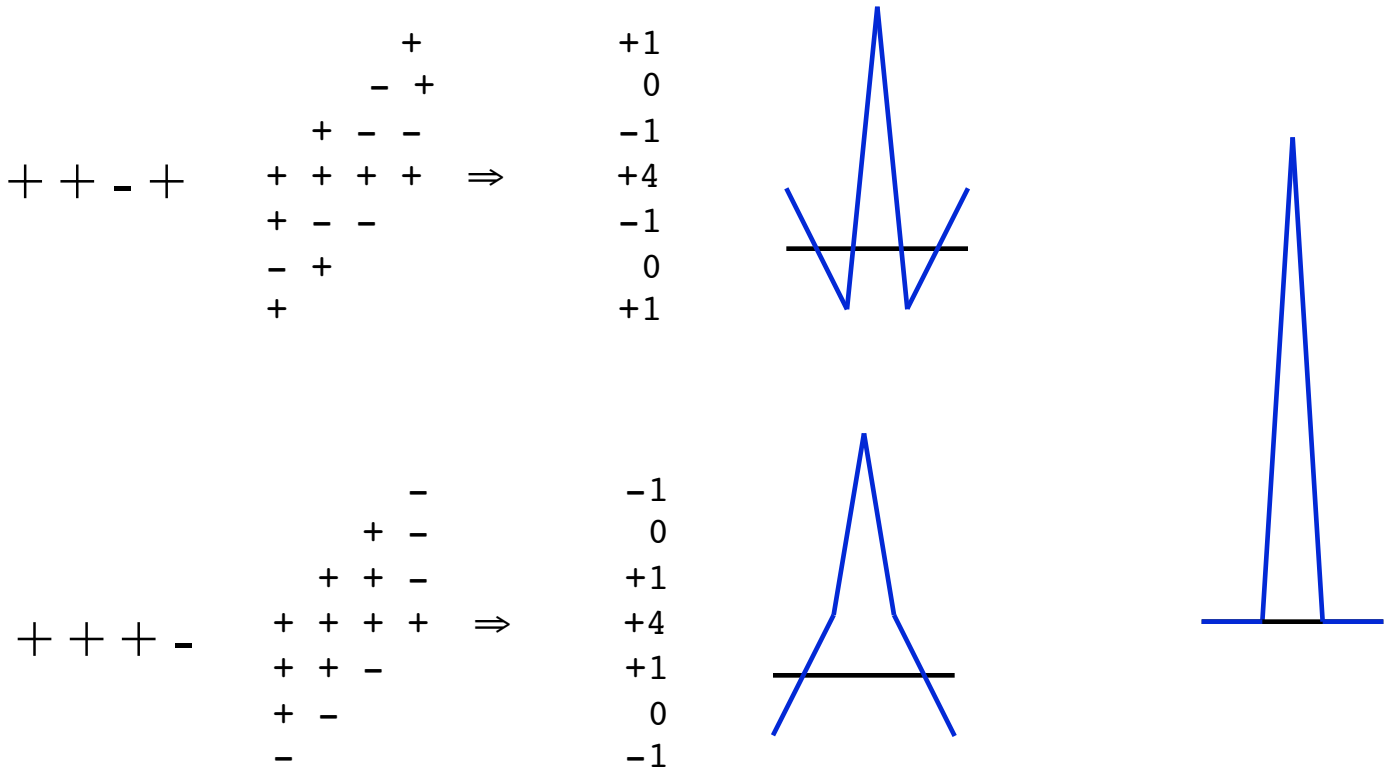
Barker Codes

2 bit	+ -
3 bit	+ + -
4 bit	+ + - +
5 bit	+ + + + -
6 bit	+ + + + - +
7 bit	+ + + - - + -
11 bit	+ + + - - - + - - + -
13 bit	+ + + + + - - + + - + - +

EISCAT – 13 bit



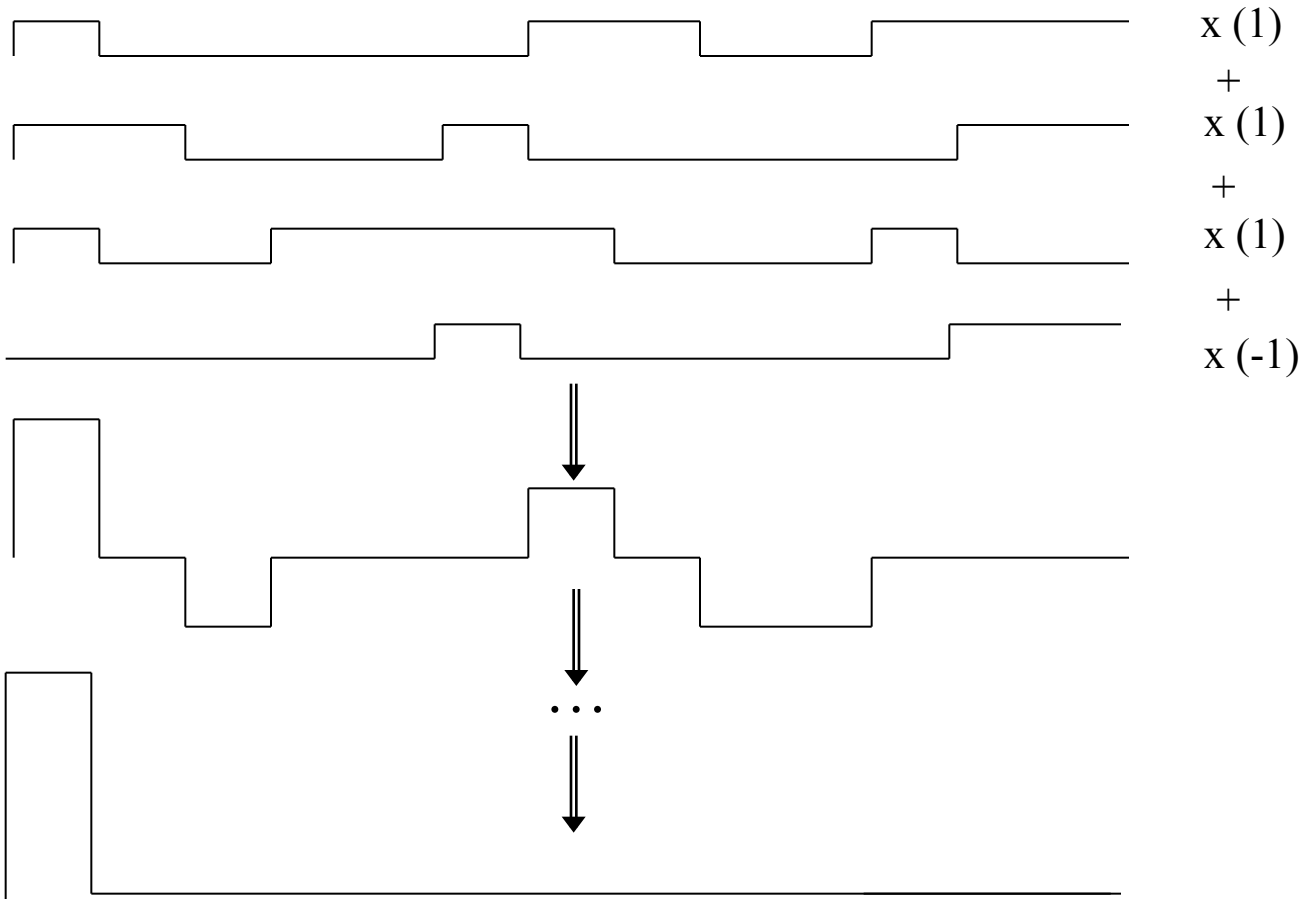
Complementary Codes



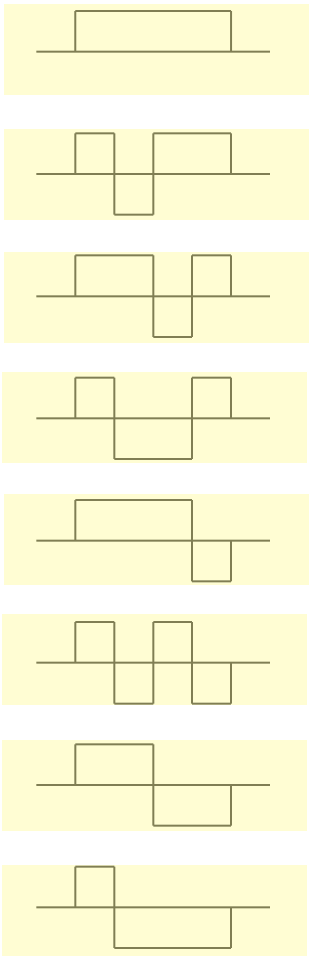
Complementary Codes

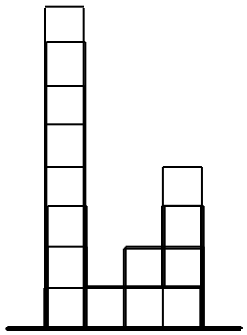
- Phase-coded pair. Net result has NO sidelobes
- For example +++- and ++-+
- If a code is A=AlAr
- Complement is $B = Al\overline{Ar}$
- Transmit both pairs and add decoded results

Random Codes



Alternating Codes





++++

+-++

++-+

+--+

+++-

+-+-

++--

+---

8000

Alternating Codes

Alternating code		2^{nd} height gate decoded
++++	(x)	++++
+−++	(-x)	−+−−
++−+	(x)	++−+
+−−+	(-x)	−++−
+−+−	(-x)	−+−+
+++−	(x)	+++−
++−−	(x)	++−−
+−−−	(-x)	−+++

Multiply by

1^{st} lag

+++	+++
−−+	++−
+−−	+−−
−+−	+−+
−−−	+++
++−	++−
+−+	+−+
−++	+−−