Data Analysis and Fitting: Introduction

Ashton S. Reimer[1]

[1]Center for Geospace Studies
SRI International

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The Big Picture

You should be familiar at an introductory level with the following topics:

- Radar
- Radar Signal Processing
- Statistical Signal Processing
- Incoherent Scatter Radar Theory

The Big Picture

The IS Radar Technique:

- **Radar:**
    - Send megawatt pulse, receive femtowatt signals
- **Scattering Process: Stochastic Signal**
    - Voltage samples of received signals are correlated zero-mean Gaussian random variables
- **Autocorrelation Function (ACF):**
    - All information about the plasma is encoded in the second moment
- **IS Radar Theory:**
    - Relationship between ACF (equivalently, the power spectrum) and ionospheric plasma parameters: N_e, T_e, T_i, V_{los}
- **Ambiguity and "Measured" ACF lags:**
    - Measurement technique influences the measurement

Data Analysis and Fitting

Questions:

- What does "fitted data" mean?
- What are the key concepts and techniques we use to "fit" data?
- How do we go from voltage samples to N_e, T_e, T_i, V_{los}?
- How do I work with and interpret IS Radar data products?

Topics to Cover

- **Data Modeling**:
  - Forward and Inverse Problems, Least-Squares
- **Errors and Goodness of Fit**:
  - Confidence Intervals and Reduced Chi-Squared
- **Calibration**:
  - Calibrating measurements to remove hardware bias
- **Fitted and Derived Data Products**:
  - An overview with examples
- **IS Radar Data Analysis**:
  - Interpreting and working with IS Radar data products

Sneak Peak Inside The Black Box

Compare measurements and modeled measurements: