

Data Analysis and Fitting: Introduction

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The Big Picture

Summary of topics you should be familiar with from previous lectures:

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

The Big Picture

The ISR Technique:

- **Radar:**
 - Send megawatt pulses, 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
- **ISR 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

Questions:

- What does “fitted data” mean?
- What are the key concepts and techniques we need 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 ISR data products?

Topics to Cover

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

Sneak Peak Inside The Black Box

