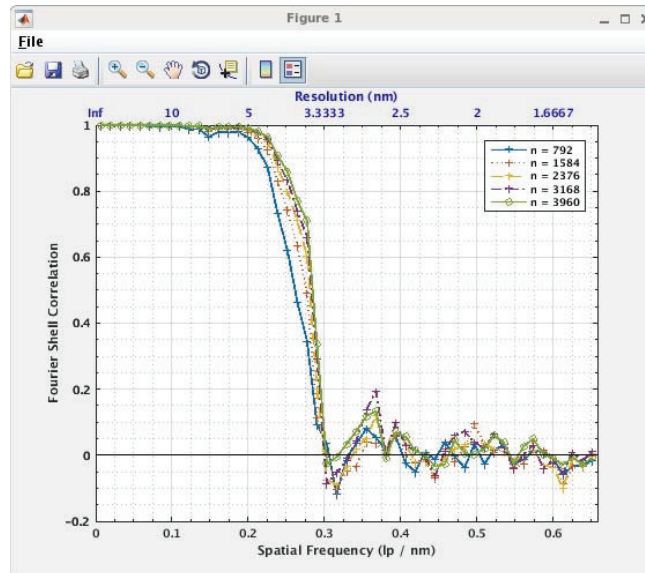


# Fourier Shell Correlation

## The Key Idea

- Correlation between volumes can be written as a product in Fourier space
- The Fourier space product can be split into shells by radial frequency
- Compute plot of correlation versus frequency

## Sample FSC Curve



X. FSC

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## Types of FSC

- Odd / even
  - Simplest
  - Random sampling generalization allows error bars
  - Subject to bias: half datasets are not independent
- "Gold standard"
  - 2 independently aligned half datasets
  - Reduces possibility of bias
- Comparison with unrelated solution

X. FSC

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## PEET FSC Programs

- calcFSC: compute simple FSC  $\pm$  errors bars
- calcUnbiasedFSC: compute gold standard FSC
- plotFSC: plot curves from above programs
- simpleFSC: compute and plot a single FSC from comparison of 2 volumes
  - Requires only volumes... no motive lists, etc.
  - Gold standard FSC
  - Comparison with independent solution

## PEET FSC Programs

- calcFSC
  - Requires a single PEET alignment
- calcUnbiasedFSC
  - Requires 2 alignments with ~identical settings
- plotFSC: plot curves from above programs
- simpleFSC
  - Needs only 2 aligned volumes

## Cross-correlation Coefficient and SNR

- Ideally (infinite data and uncorrelated noise):

$$CCC = \frac{SNR^2}{1 + SNR^2} = \frac{1}{1 + NSR^2}$$

$$SNR = \sqrt{\frac{CCC}{1 - CCC}}$$

- Where  $SNR = \frac{S(\text{amplitude})}{N(\text{amplitude})} = \sqrt{\frac{S(\text{energy})}{N(\text{energy})}}$

## FSC and Resolution

- FSC measures consistency **not** resolution
- This distinction is often overlooked or ignored
  - Resolution  $\sim 1 / \text{frequency}$
  - Use  $1 / \text{frequency}$  at which FSC = cutoff as resolution
- Typical cutoff values
  - 0.143 (or 0.15) for gold standard FSC
    - Corrects for using only half the data during FSC
  - 0.143 or 0.5 for ordinary odd / even FSC

# Questions?