3D Visualization for SIMS Analysis

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- **Goal:** An efficient, intuitive, and powerful SIMS data visualization suite
  - Primary ion sources based on molecular clusters open the door to molecular depth analysis using SIMS
  - A three dimensional (3D) chemical description of a solid sample is intriguing

- **Challenge:** High demand on computing resources and visual presentations
  - A large number of analysis layers
  - A large number of pixels at each layer
  - High resolution mass spectrum at each pixel

- **Approach:**
  - A data compression scheme for rapid loading of the entire 3D data space
  - Interactive views of 3D perspectives and 2D layers
  - Interactive color maps and visibility controls to reveal detailed structures

- **A 3D perspective view**

  - Three 2D orthogonal slices through the 3D space

- **Interactive views: 3D and 2D**

- **Interactive Color Map**
  - A customized color space
  - A controllable log-exponential value-to-color mapping function
  - Supports real-time interactive adjustment allowing the human eye to distinguish many more distinct gradations in 3D data space

- **Selected Ion Color Map**
  - **Selected Ion Intensity Space:**
    - Computes selected ion count on user-specified ion ranges
    - Supports the combination of multiple ranges for various purposes
      - Remove interferences
      - Reveal regions of interest
      - Classify the data points

- **Interactive Visibility Control**
  - Data Point Visibility
    - Filter data points based on their intensities to reveal detailed 3D structures
    - An intensity space is defined by the maximum and minimum intensities
    - A user-specified threshold controls the percentage of the visible intensity space
    - Supports real-time interactive adjustment

- **Future Work**
  - **Multiple Visual Maps**
    - **TIC map:** total intensity count (TIC) at each data point
      (i.e., the sum of intensities in the entire spectrum of each point)
    - **SIC map:** selected ion count (SIC) at each data point
      (i.e., the intensity at a specific ion range of interest)
    - **ROI map:** region of interest (ROI) in the entire data space such as a "Cell Map" that indicates the points inside a cell
  - **Multiple 3D Visuals:** show multiple scalar maps simultaneously such as TIC and SIC control various 3D visuals including different shapes, sizes and colors