# The Problem of Polydispersity: Tackling Complex Spectra with a Bayesian Approach

### Overview

UniDec uses a Bayesian approach to provide rapid, robust, and universal deconvolution of mass and ion mobility spectra with minimal user intervention

### Introduction

- Data analysis is a critical component of mass spectrometry (MS) and ion mobility-mass spectrometry (IM-MS)
- Previous approaches struggle with complex spectra or require extensive manual guidance
- UniDec can incorporate information on charge, mass, and isotopic distributions

Methods

- Does not require a model or an initial guess
- Fast analysis of complex spectra from polydisperse systems





### UniDec Screenshots

- UniDec was written in C and compiled with the Intel C Compiler as a parallelized executable
- Python interface processes data and plots results
- DMPC Nanodisc spectra were collected on modified Waters Synapt G1 with linear drift cell
- AmtB Nanodiscs and myoglobin were analyzed with a modified Thermo Q-Exactive

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## UniDec Approach



### Polydisperse Small Heat Shock Protein Assemblies Combined αB-crystallin sHSP forms CID Spectra polydisperse assemblies that heavily overlap in m/z UniDec extracts oligomeric distribution Dissociation states are 16000 24000 3200 separated by charge and m/z (Th show different distributions

500 750 1000 Mass (kDa)



• CID efficiency varies as a function of size

16850

16950

Mass (Da)



- UniDec deconvolution separates spectrum into a new charge dimension
- Transformation converts m/z to mass and arrival time to collision cross section (CCS)
- UniDec agrees with MaxEnt and Waters Transform









### Isotopic Deconvolution

Most Abundant Mass Theoretical: 16950.989 16950.984 0.3 ppm

- distributions to Adding isotope peak shape allows determination of monoisotopic mass from deconvolution
- Isotope distributions can also be used directly to determine charge for large and small molecules





### Nanodisc Lipoprotein Complexes UniDec deconvolves 2D DMPC ND 120V IM-MS of DMPC Nanodisc lipoprotein complexes CCS shows Average collapse of disc at increased collision voltage AmtB Monome + POPC**AmtB Trimer** AmtB Nanodisc Mass (kDa) Subcomplexes POPC High-resolution MS of membrane protein Nanodiscs reveal intact Nanodisc subcomplexes, AmtB ejected trimer, and monomers 12000 m/z (Th)

### Conclusions

• UniDec is a universal approach for deconvolution of polydisperse and complex MS and IM-MS spectra

 Deconvolution of small heat shock protein assemblies reveals oligometric distributions of independent dissociation states

 Isotopic deconvolution allows UniDec to analyze small molecules and provides accurate determination of monoisotopic mass

 UniDec reveals collapse of DMPC Nanodiscs and metastable dissociation states in AmtB Nanodiscs

### References

• Marty, et al. Anal. Chem. 2015, 87 (8), 4370–4376.

• αB-crystallin image: www.cgl.ucsf.edu/chimera/data/

acryst2011/acrystdemo.html

• UniDec software is available for download at:

# unidec.chem.ox.ac.uk

