

Digital Signal Processing

- The Analog-to-Digital Converter Can Operate Much Faster than the Minimum Rate for Defining Frequency
 - Nyquist Theorem Requires $2 \times SW$ (e.g. 12,500)
 - DRX-500 Samples at 400,000 Samples / sec.
- Oversampling Records Many More Samples Than Needed
 - If $SW = 6,250$ Hz, We Are Oversampling by:
 $400,000 \text{ Samples} / 12,500 \text{ Samples} = 32$
 - Much Greater Precision Because Each Sample is the Average of 32 Samples
 - Decimation is the Process of Reducing the Number of Samples Back to $2 \times SW$
 - Bruker Parameter DECIM = 32 (Decimation Factor) in This Example
- Decimation is Not A Simple Average
 - A Filter Window Moves Through the Data, Stopping Every DECIM Points and Multiplying:
 $c1*d129 + c2*d130 + c3*d131 + c4*d132 \dots$
 - The Shape of the Window Function (e.g. sinc) Determines the Shape of the Digital Filter
 - Goal is a Sharp Cutoff at $+SW/2$ and $-SW/2$: A “Brick Wall” Filter
 - The Digital Filter Stops All Peaks Outside the “Brick Wall” From Aliasing Into the Spectral Window