

# I-DEAS Vold-Kalman Tracking Filter Software

## For Tracking Responses and Loads



The I-DEAS Vold-Kalman Tracking Filter software is used for high performance tracking of harmonic responses, or orders, of periodic loads in mechanical and acoustical systems. Closely spaced and crossing orders can be extracted from systems with multiple shafts, and possess a finer frequency and order resolution than more conventional techniques. These tracking capabilities are independent of slew rates. Harmonic amplitude and phase are functions of the load and the transfer characteristics of the system, and are called the complex envelope. The filter tracks the complex envelope as a function of time and is symmetric in time, such that there is no phase bias. Because tachometer information is used for the estimation, the complex envelope may also be expressed as a function of axle speed or rpm. The harmonic waveform may be generated from the complex envelope and the tachometer information for synthesis and editing purposes.

### Applications

- ▶ Accurate determination of phase and amplitude of first axle order for multiplane balancing and troubleshooting of industrial rotating machinery foundations.
- ▶ Separating drive shaft orders from wheel orders in suspension tuning.
- ▶ Isolating order interaction phenomena in subjective sound quality studies.
- ▶ Sound quality synthesis studies.
- ▶ Tracking dopplerized orders in pass-by tests.

Order tracking with the filter is a post-processing operation, which should be used in conjunction with waterfall and spectrogram visualization for optimal insight in the data. Because of the resolution of the filter, the tachometer analyses must be precise, such that an inspection of the raw and fitted rpm estimates is recommended. An inspection of waterfalls or spectrograms of the original and masked data to verify choice of bandwidth and decoupling options should accompany the extraction of orders.

### Comparisons

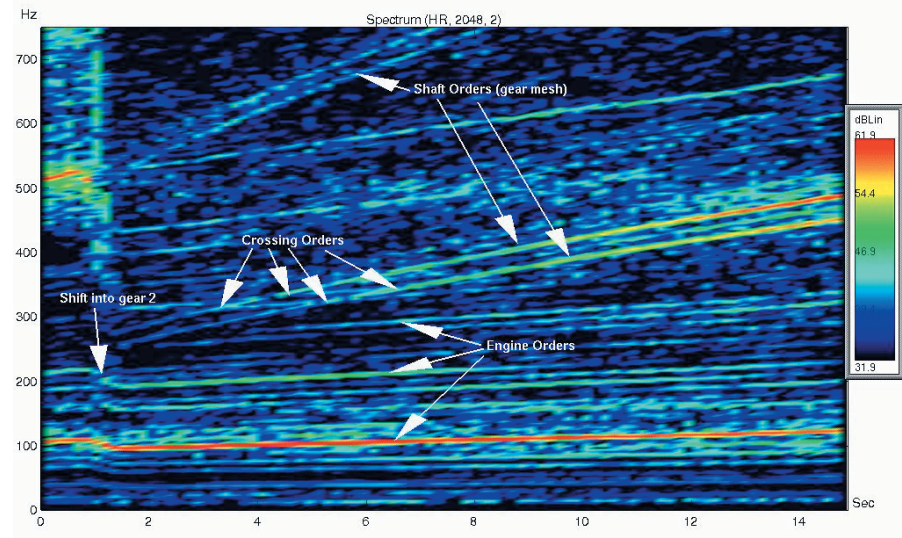
- ▶ Versus all previous methods, Vold-Kalman offers beat-free decoupling of close and crossing orders as well as advanced tachometer processing including automatic wild point rejection.
- ▶ Versus FFT-based Order Cuts, Vold-Kalman offers no leakage, finer reso-

lution, complex envelope, as well as waveform and no slew rate limitation.

- ▶ Versus computed order tracking, Vold-Kalman offers finer resolution, complex envelope, as well as waveform and no slew rate limitation.
- ▶ Versus digital tracking filters, Vold-Kalman offers much shorter transients, no phase bias (unless digital filter is FIR or filtered in both directions), complex envelope in addition to waveform, and no slew rate limitation.
- ▶ Versus previous Kalman tracking filters, Vold-Kalman offers explicit bandwidth specification, multiple filters for flat pass-band, direct extraction of the complex envelope, and one half the computational complexity.

### Prerequisite

I-DEAS Core Test™ or I-DEAS Sound Quality Engineering™



Typical data for which Vold-Kalman filtering is required.



	<b>Vold-Kalman</b>	<b>1st Generation Kalman</b>	<b>FFT Based Order Cuts</b>	<b>Computed Order Track</b>	<b>Digital Track Filters</b>
<b>Beat-free decoupling of close and crossing orders</b>	Yes	No	No	No	No
<b>Leakage</b>	Yes	No	No	No	No
<b>Phase bias</b>	No	No	N/A	N/A	Yes (unless filtered in both directions)
<b>Transients</b>	No	No	N/A	N/A	Yes
<b>Complex envelope</b>	Yes	Yes	Yes (after demodulation)	Yes	No
<b>Waveform</b>	Yes	Yes	No	No	Yes
<b>Explicit bandwidth specification</b>	Yes	No (Harmonic confidence factor)	Yes	Yes	Yes
<b>Slew rate limitation</b>	No	No	Yes	Yes	Yes
<b>Multiple filters</b>	Yes	No	N/A	N/A	Yes