THINK INSPIRE CREATE

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ASN Filter Designer to generate Arm CMSIS-DSP code for MDK

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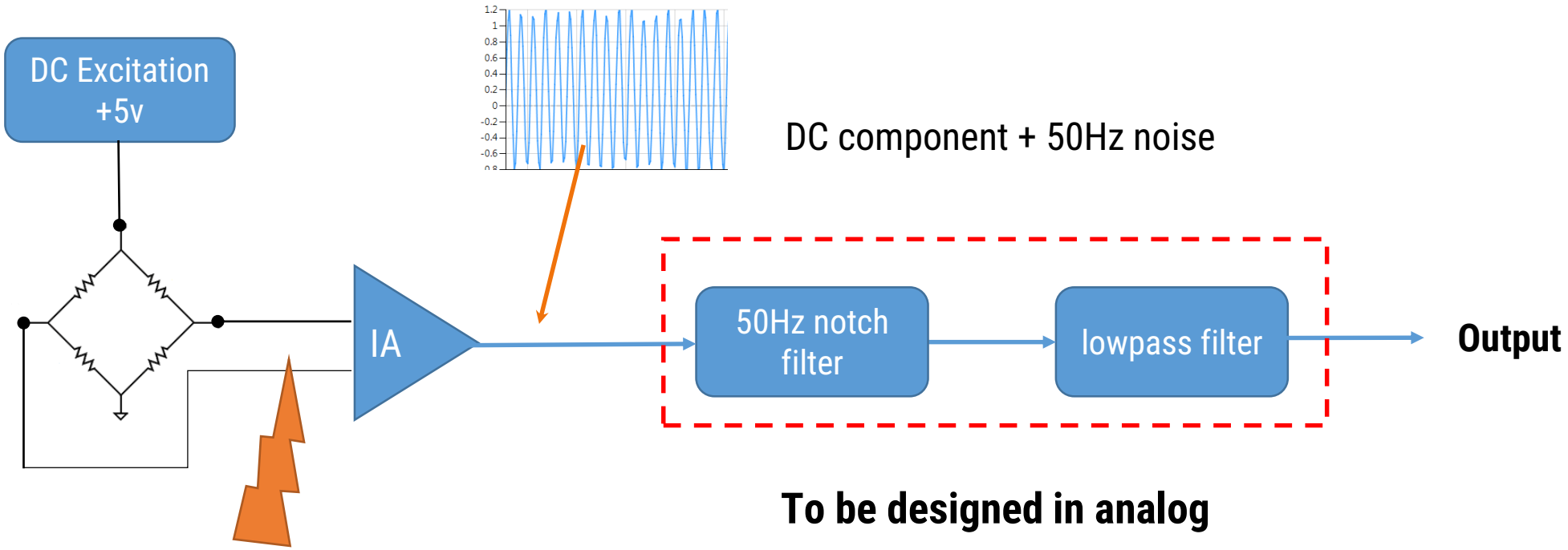
Sensor measurement data

- Sensors available in all varieties (audio, pressure, temperature, weight etc.)
- All sensors produce measurement data
- Wanted components
- Unwanted components (white noise, 50/60Hz powerline interference, glitches etc.)

Loadcell measurement: analog



To be designed in analog

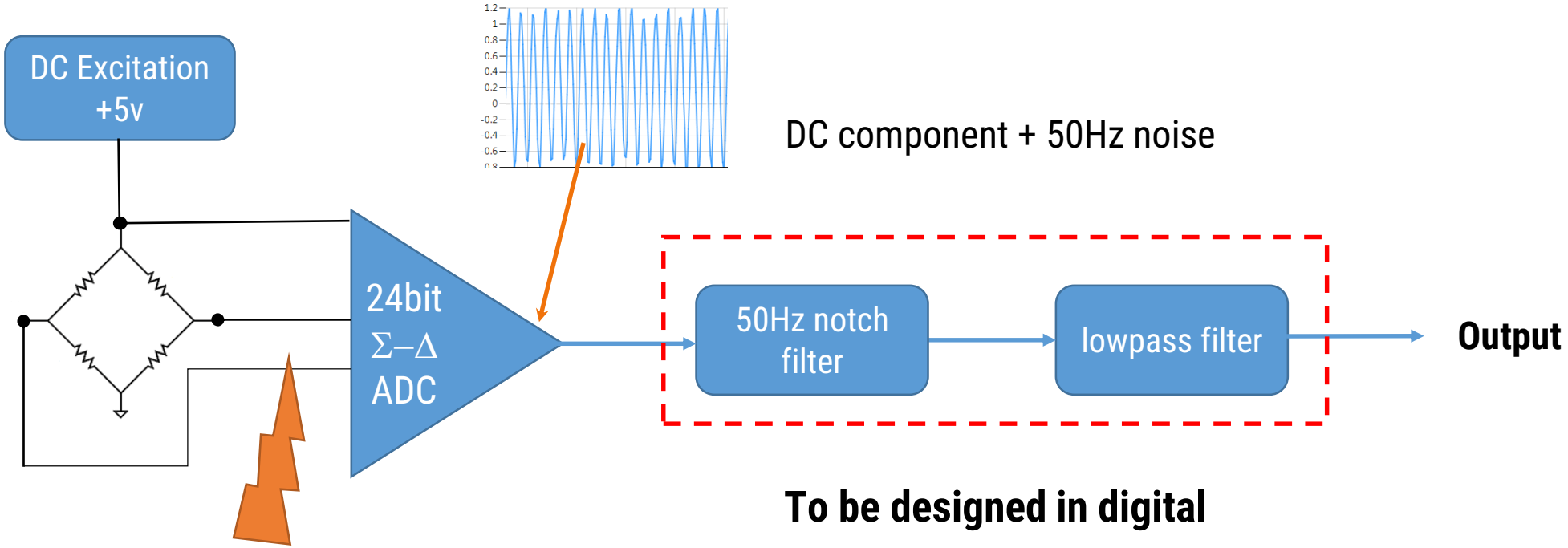
Pros

- IA has high impedance inputs, easy to add RFI/EMI filters.

Cons

- Mismatch between input EMI filters degrades IA's CMRR.
- Large differential voltage amplification.
- Notch depth dependent on component tolerances.
- More PCB area required and layout critical.

Loadcell measurement: digital



Pros

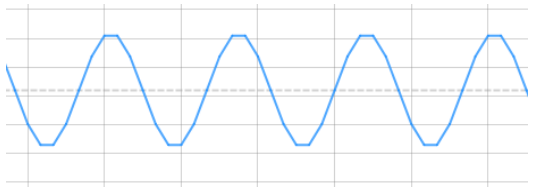
- Some Σ–Δ ADCs have a built-in 50/60Hz notch filter.
- Simple interface circuitry.
- Much more flexible than analog.

Cons

- Simple RC EMI filter not always possible, as many ADCs don't tolerate high impedance at input.
- High performance ADCs can be expensive.

Loadcell measurement: the signals

unwanted component



50Hz sine (powerline interference)

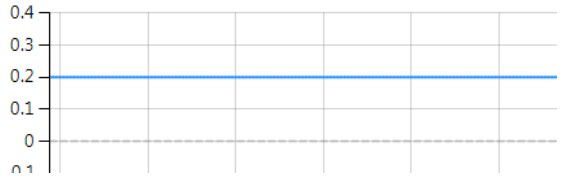
+

unwanted component

white noise (measurement noise)

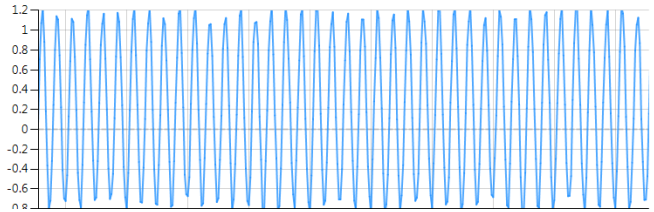
+

Wanted component



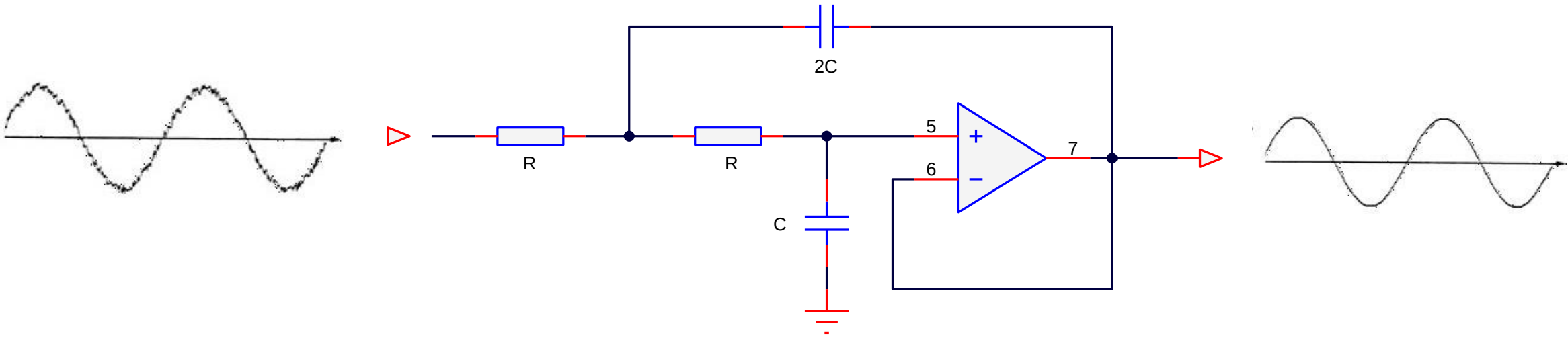
desired signal (DC component)

=



net sensor signal

ASP vs DSP: analog



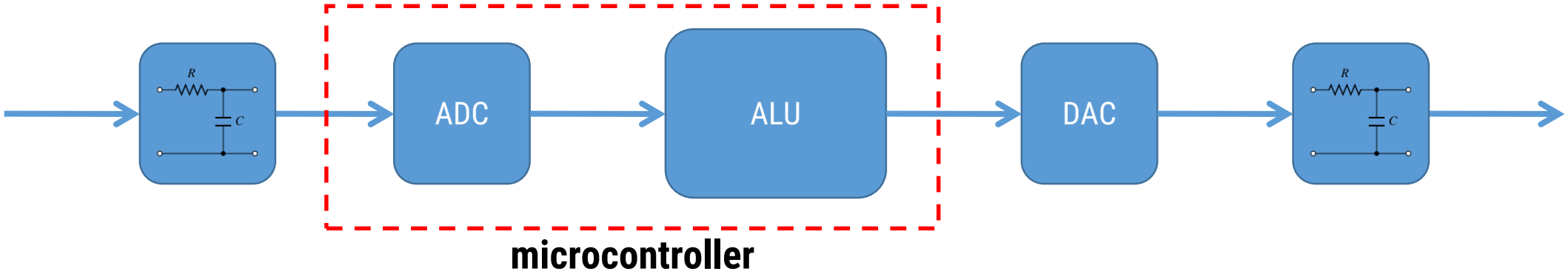
Pros

- Excellent resolution/dynamic range with a relatively simple setup.
- Good EMC properties.
- No aliasing (i.e. simple op-amps without auto-calibration and chopping).
- Can be low cost.

Cons

- Characteristics alter over time (component aging, temperature drift).
- Component tolerance affects performance.
- Requires good analog design skills.
- Fixed frequency response (e.g. Butterworth, Bessel…).
- PCB layout and component choice critical.

ASP vs DSP: digital



Pros

- High repeatability of characteristics (identical per filter).
- Bespoke design characteristics (adaptive, flexible).
- Can easily be integrated and modified within a microcontroller – no extra PCB components needed!
- Linear phase (FIR).
- Very low frequency filtering (<1Hz, good for biomedical).

Cons

- Effects of aliasing.
- FWL issues (if FP implementation).
- ADC/DAC resolution (high resolution is expensive, and has higher power requirements.)
- Produces more EMI than analog.
- Requires specialised design tools.

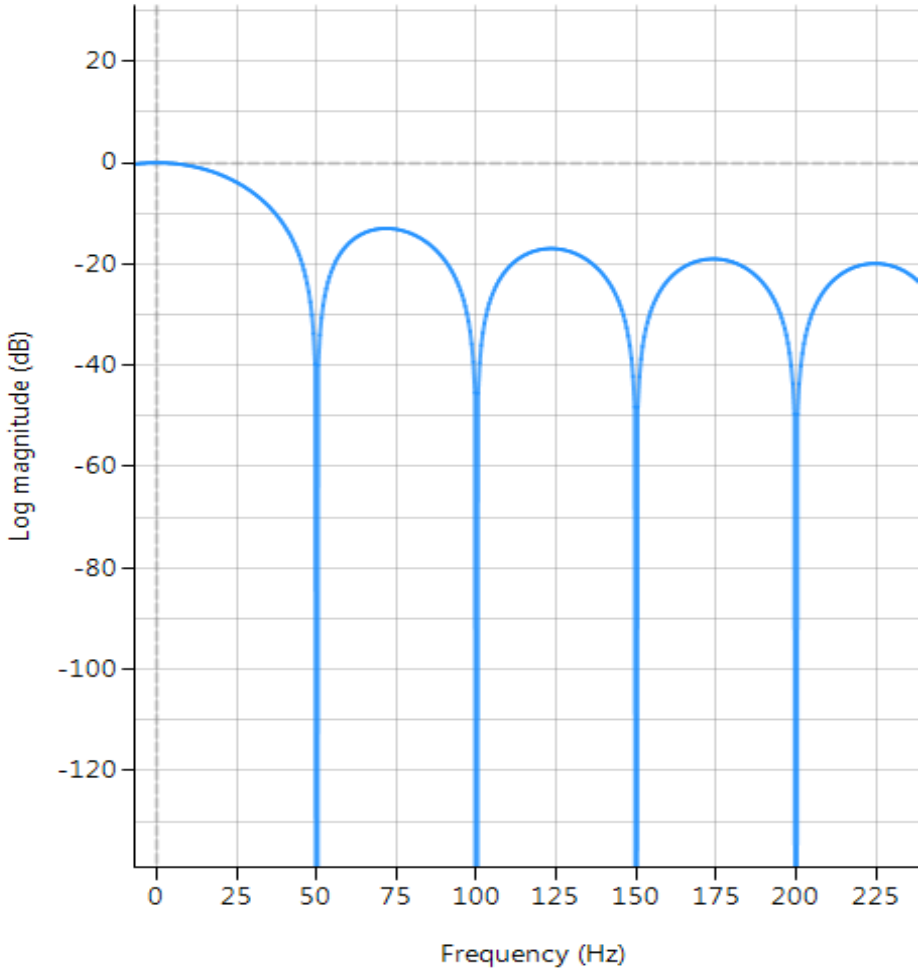
ASP vs DSP: the moving average (MA) filter

Pros

- Most commonly used digital lowpass filter.
- Optimal for reducing random noise while retaining a sharp step response.
- Good smoother (time domain).
- Unity valued filter coefficients, no MAC operations required.
- Conceptually simple to implement.

Cons

- Inflexible frequency response: nudging a conjugate zero pair results in non-unity coefficients.
- Poor lowpass filter (frequency domain): slow roll-off and terrible stopband attenuation characteristics.



Fixed Point or Floating Point?

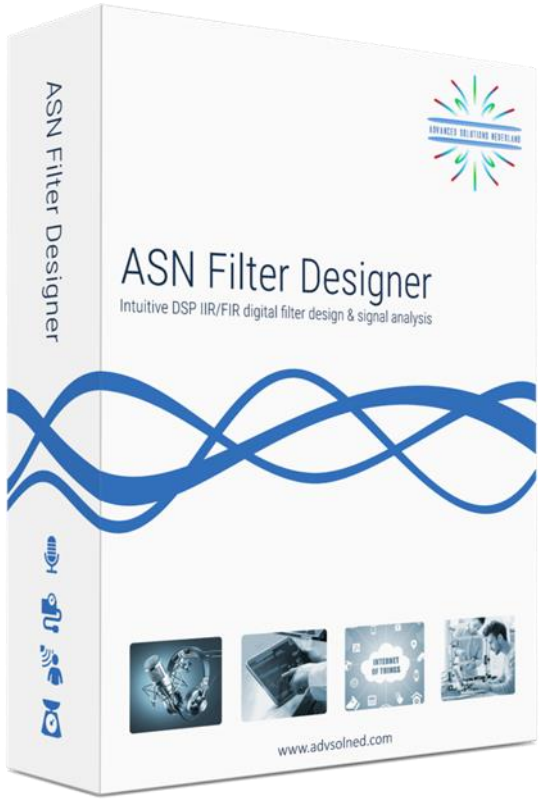
Historically

- Floating Point hardware only available in expensive DSPs (major players: TI and ADI).
- Not suitable for low cost sensor applications.
- Targeting high performance signal processing applications (pro audio, military, highend medical).
- Good library support: Relatively easy to implement from Matlab or C (no FWL issues).

- Fixed Point suitable for low cost, very low-power portable applications.
- FWL considerations increases design time.

Arm Cortex-M based microcontrollers

- Cores implemented by many international IC vendors (NXP, TI, ADI, ST, Maxim…).
- Cortex-M4 and M7 cores have hardware floating support (enhanced microcontrollers).
- Freely available CMSIS-DSP C library: Fixed point and floating point (single precision).
- Low cost solution (microcontroller with DSP functionality all-in-one).



ASN Filter Designer

Solving all your filtering challenges