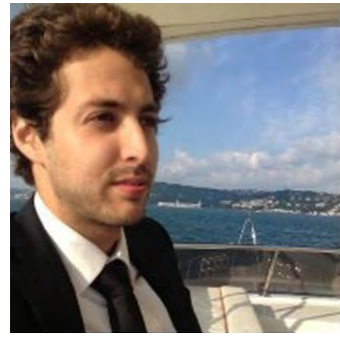


# Signal processing challenges of measurement and logging while extended reach drilling in the North Sea

by Peter Shulgin, CEO Axel



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Today the vast majority of drilling companies use mud-pulse telemetry for transmitting measurements and logging while drilling (MWD/LWD) data to the surface in real time. However, external conditions like pumps, mud consistency, and drill string movements reduce the quality of data received at the surface. Obstacles that decrease the percentage of decoding include sporadic noises caused by drill string movements and mud motor operation, as well as ongoing noises created by pumps and electric systems on the rig. In addition, the signal level from MWD systems decreases as depth increases, making the transmission channel less reliable as drilling progresses. Transmark EDS, one of the most experienced directional drilling companies in the North Sea region, operates in extremely challenging conditions. They often are forced to place mud pulse MWD systems below the motor or use them in conjunction with rotary steerable systems. Such workarounds create significant decoding challenges. Based on the recommendations of other drilling contractors, Transmark EDS decided to try the recently developed Axel

Surface Unit to reduce the effects of pump noises and high torques on their operations as shown in Figure 1. Axel is an independent MWD manufacturer founded in 2012 in response to a market need for standardized communications for MWD/LWD systems operating in extreme environments. Axel's first major goal was to improve decoding quality in mud pulse telemetry by developing a universal surface solution. Their solution, the Axel Surface Unit, offers hardware and software compatible with different types of MWD downhole tools. Axel's team successfully implemented advanced signal processing algorithms and cutting-edge machine learning

techniques to take decoding systems to the next level. When Transmark EDS started drilling with Axel in 2014, the unit was quickly developing a reputation as the best surface system available on the international market. Initially, Transmark EDS ran the Axel Surface Unit in parallel with their previous surface solutions. Comparative performance testing showed that Axel outperformed competitors during drilling in the North Sea region. The Axel Surface Unit consistently decoded sections for which other systems showed poor decoding or no decoding at all. Axel's superior performance is based on a combination of features for noise reduction, including specially designed smoothing

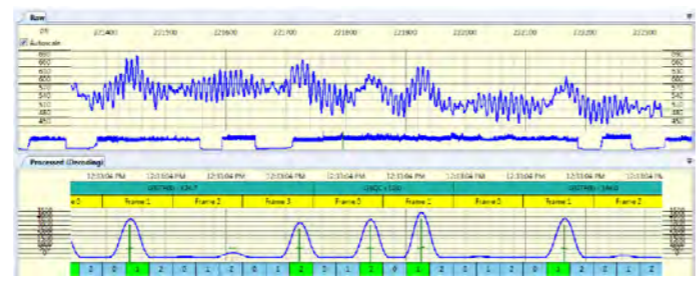


Figure 1. High torques processed by Axel Decoder

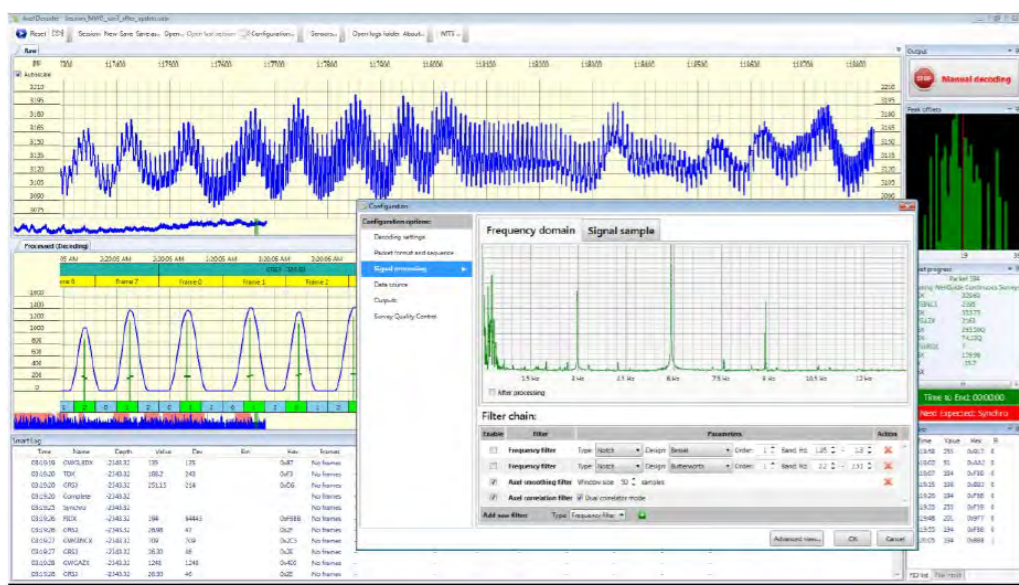
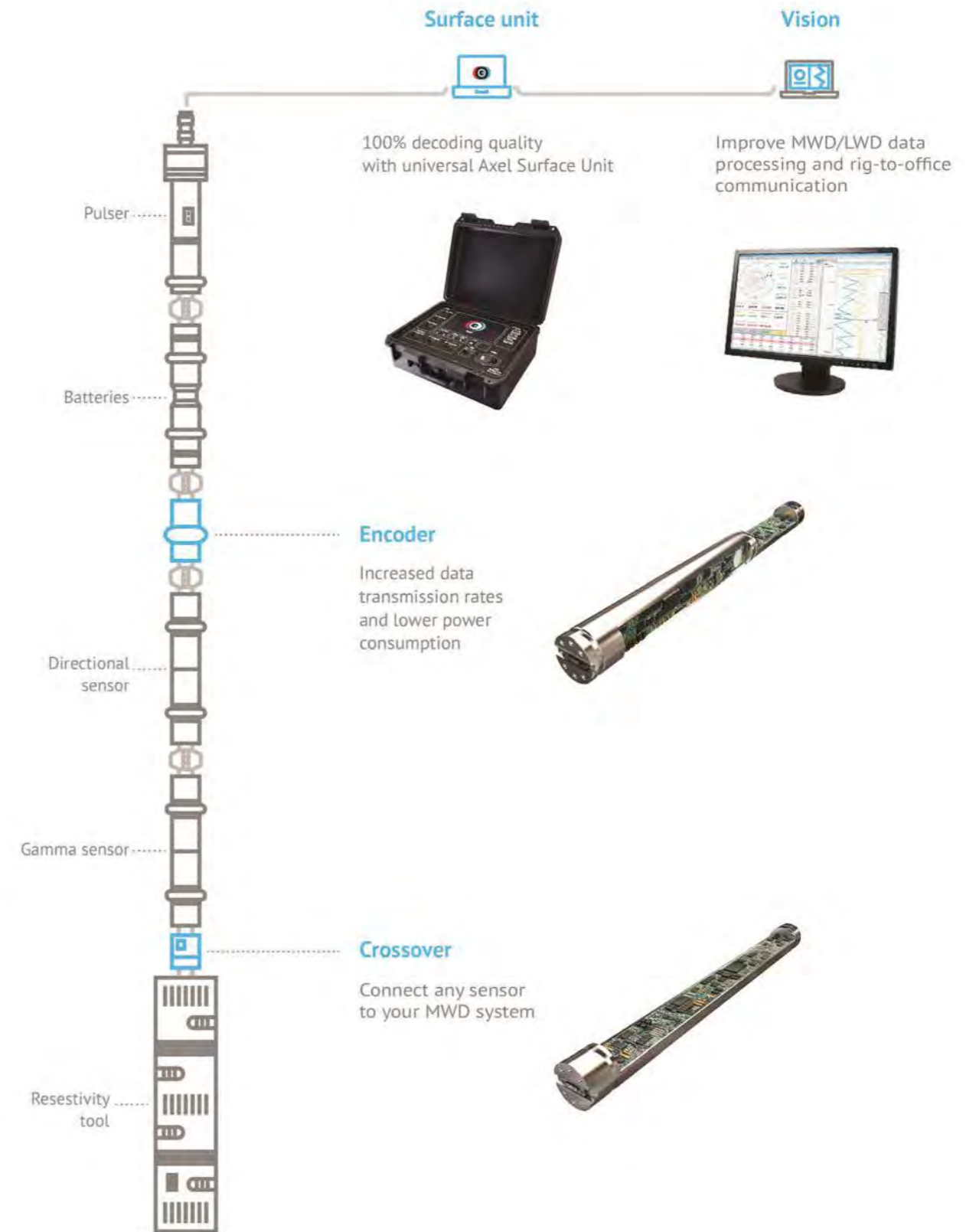


Figure 2. The combination of Axel Smoothing Filter and Axel Correlation Filter helps to remove spikes from the frequency domain

and correlation filters as shown in Figure 2. A manual toolkit allows MWD engineers freedom to manage the decoding process in real time and manually decode the most problematic signal intervals. This significantly improves decoding quality and resolves many decoding issues. Axel's technical team is very responsive to client requests. The flexible and scalable architecture of each unit makes it possible to quickly build case-specific improvements and push software updates to operating surface units while drilling is in progress. Based on data provided by Transmark EDS, Axel was able to start work on a universal filter solution for noises caused by rotary steerable systems. The Axel technical team will be glad to present the results when the work is complete.



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