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The characterization of trough and planar cross-bedding from borehole image logs

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Conventional analysis of borehole images involves fitting sinusoidal curves to borehole/structure intersection curves, and assumes that the sedimentary features are planar. If trough cross-bedding occurs the conventional technique can result in large errors in the direction of the trough axis (up to $+35^o$ in dip and $\pm 90^o$ in azimuth) due to the unknown offset between the borehole axis and the trough axis. We present an analytical model describing the curves from the intersection of a vertical borehole with a mathematically generalized trough cross-bedded structure. The new model shows deviations of the trough axis from sinusoidal behavior that increase as the dip and the width of the trough decreases, and as the offset increases. The conventional and new techniques have been compared by using both of them to analyze blindly a set of mixed plane and trough cross-bedded FMI data. This analysis shows that the new technique provides (i) improved accuracy in dip and azimuth determinations, (ii) additional information concerning the width of the trough and the offset, and (iii) enhanced vertical resolution arising because accurate directional data can be obtained for individual structures, enabling each structure to be accurately and uniquely mapped in three dimensions in the sub-surface.