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Interactive comment on “Investigation of the Effects of Surrounding Media on the Distributed Acoustic Sensing of Helically-Wound Fiber-Optic Cable with Application to the New Afton Deposit, British Columbia” *by* Sepidehalsadat Hendi et al.

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We would like to appreciate the reviewer for her/his thoughtful comments and efforts towards improving our manuscript.Bellow is our response to the issues raised in the review:

GC 1: The paper aims at presenting FE modeling results showing the effect of various geological scenarios on DAS data acquired with a helically wound cable. The various scenarios were chosen to help assess possible causes of weak-amplitude data acquired at the New Afton mine using a HWC cable. We will clarify this in the revised manuscript. In the revised version, the code will be provided, and the structure of appendix will be modified according to the referee suggestion.

GC 2: a and b) In Fig 12 to 17, the radial strain around the cable as a response of compressional wave propagation in 90° incident angle is shown. In this FE modelling, the HWC fiber strain is calculated based on radial and axial strain of cable by considering wrapping angle (α) equal to 30 degree, according to the following equation:

e_(HWC fiber)=e_axial*ãĂŰsinãĂŮˆ2 α+e_radial*ãĂŰcosãĂŮˆ2 α

c and d) Indeed, the cable is not exhibiting higher strain in these scenarios. As the number of domains is higher in other scenarios and smaller mesh are assigned to the thinner domains, COMSOL resolution is not able to show these strains and that is why cable domain is shown in white in other scenarios.

e) In 3D simulation, the real dimension of geometries is taken into account, and the cable is completely bounded by surrounding material and its radial deformation is controlled by its characteristics and surrounding material. While in 2-D simulation, one dimension (y) is not considered into modelling (plain strain assumption) and whatever energy is applied by plane wave is used to make deformation in x and z direction.

f) A 3D modelling figure will be presented in revised version.

GC3: This is correct; the focus is on the HWC response only. The response of straight fibre-optic cable is well-documented in the literature (Mateeva et al. 2014, Kuvshinov 1996). Straight fibre-optic cable are sensitive to the axial strain. For plane P-waves, the sensitivity of a straight fibre-optic cable varies as a function of cos2 θ, θ being the angle between the plane wave direction and the cable. A HWC is sensitive to both axial and radial strain, the latter being dependent on the material around the cable. The FE modeling conducted in the paper aims primarily at recovering the radial strain averaged over the circumference of the cable. The response of the HWC is then obtained using equation 1 above (see response to GC2). We will clarify this in the revised manuscript.

GC4: The gauge length is the physical interval along the optical fibre over which the difference between the phases of backscattered signal is measured and used to compute strain rate (Hartog 2018). The gauge length is the main factor controlling the spatial resolution. A trace spacing less than the gauge length is generally used during acquisition as data for overlapping gauge lengths generally improve the clarity of events, especially those related to slower waves (Hartog, 2018). The same gauge length (10 m) was used for both straight and helically-wound DAS data shown in figure 22. Due to the wrapping, strain rate over the gauge length is measured over a shorter cable distance for a helically-wound fibre than for a straight optic-fibre. This resulted in more channels for the HWC data (925 for HWC vs 813 for straight fibre-optic) for cables with identical length (828.5 m). While this is an important difference between straight and helically-wound cables, it does not explain the difference between data shown in figure 22 a and b. We will add this point to the discussion in the revised version.

GC 5: Mentioned additional references will be added in revised version.

GC 6: (a), (b), (c), and (d), we will consider those comments in the revised version.

e) They are tightly overlapped; it is the reason that the slight difference is not nicely detectable.

f) More discussion will be provided in revised version, regarding fig 12 to 17. Other sections of this comment will be applied in revised version.

GC 7: We will introduce the field data earlier in the paper to improve rationale for the choice of simulated models.

GC 8: We simulated incident P-waves because it is the primary body wave used for exploration purposes. S-waves are seldom used for exploration and are usually removed from the seismic data during data processing (at least direct and refracted S-waves). Rayleigh waves only propagate along a free surface and are not suitable source waves

for the exploration of the subsurface.

GC 9: Since the maximum response of fiber optic as a function of incident angle was the main objective, simulation was conducted in the frequency domain. We do not expect significant variations over seismic frequencies.

Specific comments: (a)-(j): We will consider those comments in the revised version.

k) The quality of cement is defined by Young's modulus, density, and Poisson's ration. In this study, what distinguishes between different cements are Young's modulus and density, and different velocities. The soft and hard cement have the same Young's modulus and Poisson's ratio as the cements used in Kuvshinov (2016).

(L) We will correct it in the revised version.

(m) Interface between water domain and solid domain acts as a free surface. When a head wave hits this interface, some part of energy converts to surface waves (tube waves) and the other part as compressional wave. Fluid does not support shear waves.

References: Hartog, A.H., 2018. An introduction to distributed optical fibre sensing. CRC Press. Kuvshinov, B.N., 2016. Interaction of helically wound fibre-optic cables with plane seismic waves. Geophysical Prospecting 64, 671–688. Mateeva, A., Lopez, J., Potters, H., Mestayer, J., Cox, B., Kiyashchenko, D., Wills, P., Grandi, S., Hornman, K., Kuvshinov, B., Berlang, W., Yang, Z., and Detomo, R., 2014. Distributed Acoustic Sensing for reservoir monitoring with vertical seismic profiling. Geophysical Prospecting 62, 679–692.

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