NF-04

Detecting link anomalies caused by physical movements of patch cables using State of Polarization (SoP) monitoring

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INTRODUCTION

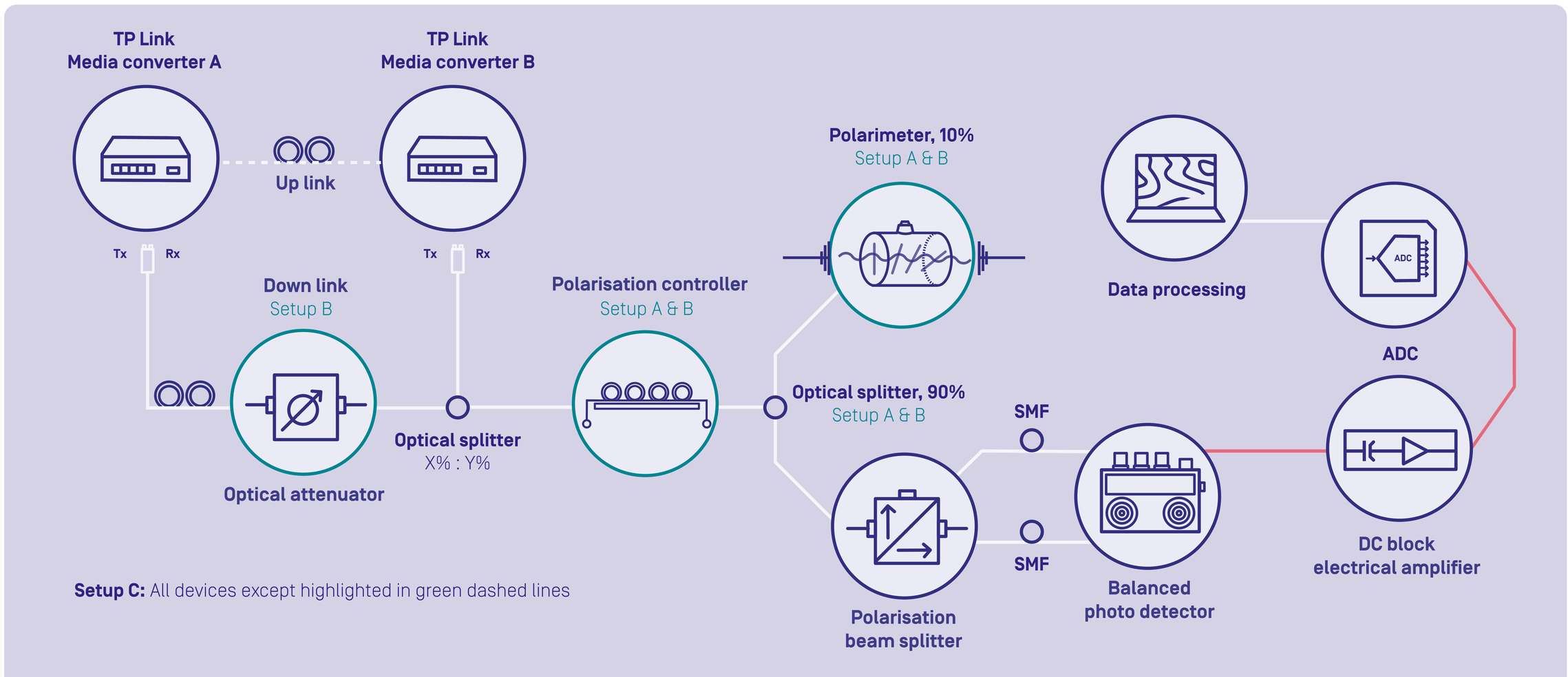
This study explores a novel and low-cost technique for detection and distinction of unexpected movements of patch cables in optical fiber networks by utilising State of Polarisation (SoP) analysis. In uncovering an effective monitoring technique, we may ensure the integrity of the network.

METHOD

1. A transmission system is created with SFP transceivers, and a simplified SoP analyser was installed at the receiver end.

2. To analyse sensitivity to direct and indirect interference, three methods were applied to imitate direct contact (e.g. tools, hands) and indirect movements (e.g. vibrations). We tested for the highest frequency detectable in direct movement using an airgun at varying distances to apply air pressure to fibres.

3. The State of Polarisation Change (SOPC) was measured at the receiver end of the optical fibre cable using our simplified SoP analyser.



Setup C: All devices except highlighted in green dashed lines

Figure 1: Experimental setup for the three different experiments. A is for characterising the frequency response and B is the receiver sensitivity of indirectly induced vibrations (X=Y= 50% splitter). Experiment C characterises a direct movement of the fibre (X=10% to receive, Y = 90% split to PBS. The polarimeter is for reference testing only.

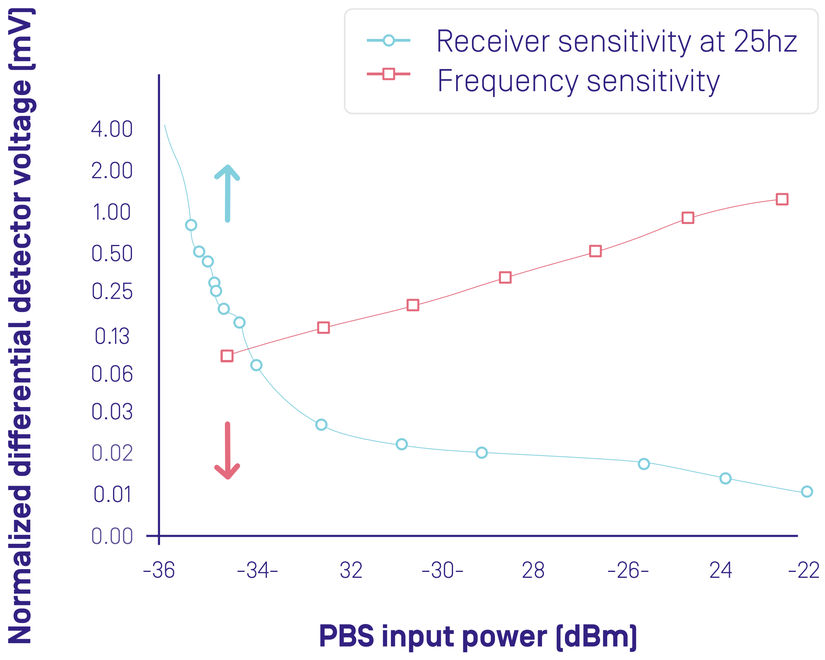


Figure 3: SOPC as a function of time for different displacements of the fibre cord hit by the air gun air-flow from different distances.

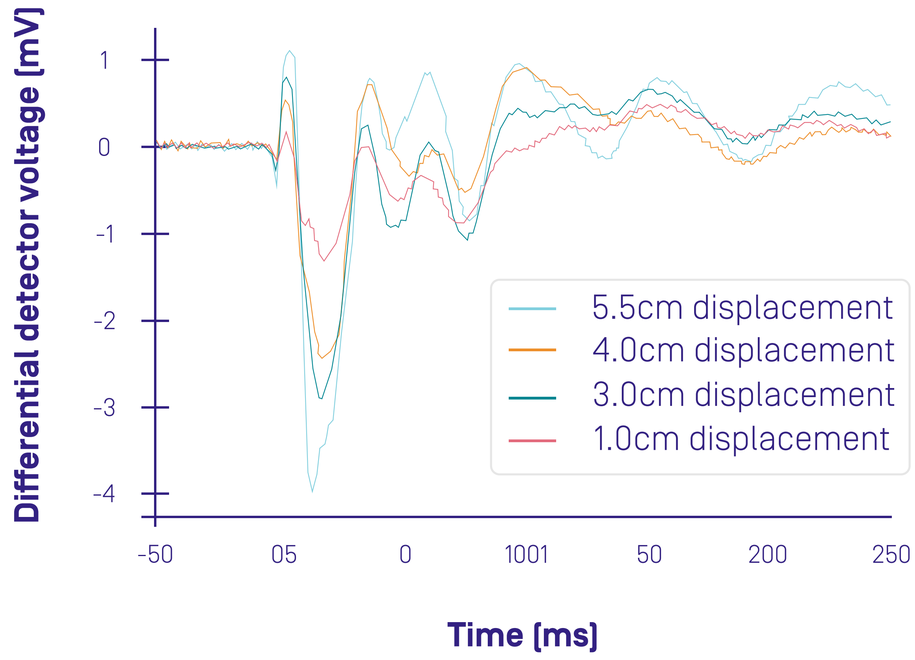


Figure 2: SOPC as a function of received optical power, for experiment B. For experiment A, SOPC as a function of induced vibration frequency for a fiber on the floor is shown.

RESULT

- Inducing vibration in a rack, the highest sensitivity is found for the lowest frequencies (25Hz), decreasing rapidly to 400Hz, where the decrease slows down.
- Direct movements typically cause a larger SOPC, especially for frequencies beyond 100Hz where the sensitivity to indirectly induced vibrations decreases rapidly.

These results prove that movements causing displacements of patch-cords may be distinguished from indirect vibrations. The detection of unexpected movements can be applied for issuing alarms and proactive protection switching.

CONCLUSION

Monitoring State of Polarisation of fibre networks increases the reliability through identifying early warning signs of interference or possible network outages caused by external forces, whether they be environmental or induced due to local activities.

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