Figure 3(b) shows the output constellation spectrum, optical frequency spectrum, eye-diagram, and pattern peaks for a three-tap correlator. EVM of 8.3% for the specific pattern of [ADB] is measured.

In addition to searching based on the number of taps, it is sometimes useful to analyze correlation in a data stream that has redundant data. Consider searching for the pattern [CCXXAA], in which the double [XX] in the middle of the pattern represents the redundant data in the stream. This can be implemented easily by turning off the fingers of the corresponding redundant pattern, as shown in the optical spectrum at Fig. 3(c). This figure also shows the eye-diagram and constellation of 25-QAM with EVM of 7.4% for the four-tap correlator as well as pattern peaks.

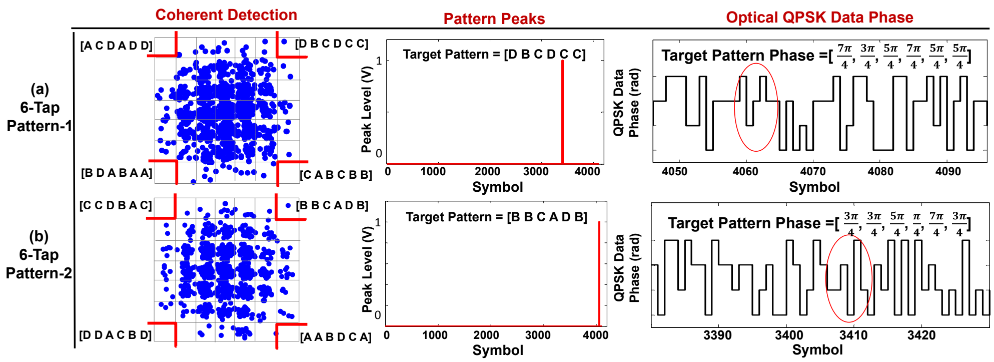

Fig. 4. Experimental results for 6-tap coherent correlator output with the pattern peaks and corresponding optical data phase for (a) Pattern [DBCDCC]. (b) Pattern [BBCADB].

Furthermore, increasing the number of taps, this configuration can also demonstrate a 6-tap optical QPSK correlator, which results in a 49-QAM matching pattern. Figure 4(a) shows the coherent correlator result for the specific pattern of [DBCDCC]. All output symbols in all four corner points of the IQ-plane can be detected as the target pattern with 0°, 90°, 180°, and −90° rotations, separately - which, in this case, will be the patterns [DBCDCC], [ACDADD], [BDABAA] and [CABCBB], respectively. Analyzing the upper right corner of the constellation yields the location of the matched patterns in a 4096 QPSK symbol stream, shown as the correlator peaks in Fig. 4(a). The phase of the mapped data stream is also shown in Fig. 4(a) to highlight the corresponding patterns in the data stream that matched with the peak level. The pattern of [BBCADB] in the data stream is also searched and the results are shown in Fig. 4(b).

5. Conclusion

We have demonstrated an optical correltor using an optical frequency comb source and a single nonlinear element. Optical frequency comb source was used to achieve the high number of coherent taps in the correlator. We have used a wavelength dependent delay to achieve the tunable delays. A PPLN crystal was used to multiplex the tapped delays of the signal utilizing the nonlinear wave mixing of SFG and DFG. We have analyzed the output of the correlator by coherent detection and successfully searched multiple patterns with different lengths in a data stream at the rate of 40 Gb/s. In order to have a correlator with a high number of taps, a PPLN crystal with a high conversion efficiency would be required as well as an advanced coherent receiver which could detect high order QAM constellations.

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