All-fiber coherent beam combining utilizing tapered fiber bundles with active phase stabilization

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The fabrication and performance of highly efficient brightness-preserving tapered fiber bundles (TFBs) have proven to work reliably at high power levels when incoherent side-by-side addition of fiber lasers is performed [1-3]. While simplicity and ruggedness are the main advantages of the method, beam quality (BQ) is yet bounded by brightness conservation [4]. Coherent beam combining (CBC), on the other hand, enables brightness enhancement along with power scaling. This method, however, is significantly more restrictive, as it requires the use of highly coherent sources in addition to phase and polarization control schemes [5]. Recently, we have presented the potential of TFBs to coherently combine fiber lasers, when a laser source was split using a 50-50 coupler and coherently combined with the use of a TFB combiner [1]. The advantage of using TFBs instead of NxN fused couplers as the combining device is twofold, since they are more efficient and suitable at higher power levels. Without active phase stabilization, the M^2 fluctuated over time between the values 1.17 and 2.3, consistent with expected results of an in-phase and anti-phase CBC, respectively. In this work, we present our latest progress following the addition of an active phase stabilization scheme. Within our talk, we will present the BQ and power efficiency results and also discuss the possibility of splicing the TFB's output facet to a delivery fiber, as was previously reported in the case of incoherent beam combining [6].

References

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