A Distributed Training Adaptive Parallel Strategy Generation Algorithm for Multi-DCs in the MAN

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***Abstract*—The challenges of distributed training across data centers (DCs) in metropolitan area network (MAN) is under-explored: prevailing pipeline-parallel (PP) methods assume single-data-center(single-DC), homogeneous and high-bandwidth low-latency clusters with full resource visibility, thus misfit cross-data-center (cross-DC) constraints of privacy and high-latency links. We present Chain-based Dynamic Programming (CDynP), a privacy-preserving planner that passes compressed state summary（SS） along a data-center chain to co-optimize model partitioning and device mapping for minimal iteration time without exposing any internal information. In cross-DC evaluations, CDynP limited iteration-time increase to 8.3% when scaling from one to four DCs—substantially less than competing baselines—highlighting its adaptability. Across larger-scale training tasks and degraded network conditions, it consistently achieved top performance, and its search was both rapid and high-quality, underscoring robustness and scalability. These results establish CDynP as a practical, privacy-compliant approach for leveraging dispersed compute islands in MAN for large-scale AI training.**

***Keyword*—Adaptive Parallel Strategy, Multi-DC Collaboration, MAN, Pipeline Parallelism, Privacy-Preserving Optimization**

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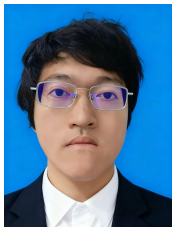

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