Power, Area and Thermal Prediction in 3D Network-on-Chip using Machine Learning

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I. PROPOSED METHODOLOGY

REFERENCES

- [1] K.-C. Chen, Y.-H. Liao, C.-T. Chen and L.-Q. Wang, "Adaptive Machine Learning-Based Proactive Thermal Management for NoC Systems," in IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 31, no. 8, pp. 1114-1127, Aug. 2023, doi: 10.1109/TVLSI.2023.3282969.
- [2] N. Shahabinejad and H. Beitollahi, "Q-Thermal: A Q-Learning-Based Thermal-Aware Routing Algorithm for 3-D Network On-Chips," in IEEE Transactions on Components, Packaging and Manufacturing Technology, vol. 10, no. 9, pp. 1482-1490, Sept. 2020, doi: 10.1109/TCPMT.2020.3018176. Keywords: Three-dimensional displays; Routing; Heat sinks; Thermal management; Manufacturing; Two-dimensional displays; Thermal sensors; 3-D network-on-chip (3-D NoC); packet routing; Q-learning; Q-routing; thermal management,
- [3] M. Guo, T. Cheng, X. Li, L. Li and Y. Fu, "A Nearest-Neighbor-Based Thermal Sensor Allocation and Temperature Reconstruction Method for 3-D NoC-Based Multicore Systems," in IEEE Sensors Journal, vol. 22, no. 24, pp. 24186-24196, 15 Dec. 2022, doi: 10.1109/JSEN.2022.3218953.
- [4] Liu, H.; Chen, X.; Zhao, Y.; Li, C.; Lu, J. TTQR: A Traffic- and Thermal-Aware Q-Routing for 3D Network-on-Chip. Sensors 2022, 22, 8721. https://doi.org/10.3390/s22228721
- [5] M. F. Reza, "Deep Reinforcement Learning for Self-Configurable NoC," 2020 IEEE 33rd International System-on-Chip Conference (SOCC), Las Vegas, NV, USA, 2020, pp. 185-190, doi: 10.1109/SOCC49529.2020.9524761.
- [6] D. DiTomaso, A. Sikder, A. Kodi and A. Louri, "Machine learning enabled power-aware Network-on-Chip design," Design, Automation & Test in Europe Conference & Exhibition (DATE), 2017, Lausanne, Switzerland, 2017, pp. 1354-1359, doi: 10.23919/DATE.2017.7927203.
- [7] F. Li, Y. Wang, C. Liu, H. Li, and X. Li, "NoCeption: A Fast PPA Prediction Framework for Network-on-Chips Using Graph Neural Network," 2022 Design, Automation & Test in Europe Conference & Exhibition (DATE), Antwerp, Belgium, 2022, pp. 1035-1040, doi: 10.23919/DATE54114.2022.9774525.
- [8] Md Farhadur Reza. 2021. Machine learning for design and optimization challenges in multi/many-core network-on-chip. In Proceedings of the 14th International Workshop on Network on Chip Architectures (No-CArc '21). Association for Computing Machinery, New York, NY, USA, 29–34. https://doi.org/10.1145/3477231.3490427.
- [9] Xinyi Li, Wenjie Fan, Heng Zhang, Jinlun Ji, Tong Cheng, Shiping Li, Li Li, and Yuxiangfu Fu. 2024. TTNNM: Thermal- and Traffic-Aware Neural Network Mapping on 3D-NoC-based Accelerator. In Proceedings of the Great Lakes Symposium on VLSI 2024 (GLSVLSI '24). Association for Computing Machinery, New York, NY, USA, 364–369. https://doi.org/10.1145/3649476.3658703
- [10] K.-C. J. Chen and Y.-H. Liao, "Adaptive Machine Learning-Based Temperature Prediction Scheme for Thermal-Aware NoC System," 2020 IEEE International Symposium on Circuits and Systems (ISCAS), Seville, Spain, 2020, pp. 1-4, doi: 10.1109/ISCAS45731.2020.9180475
- [11] E. W. Wächter, C. de Bellefroid, K. R. Basireddy, A. K. Singh, B. M. Al-Hashimi and G. Merrett, "Predictive Thermal Management

- for Energy-Efficient Execution of Concurrent Applications on Heterogeneous Multicores," in IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 27, no. 6, pp. 1404-1415, June 2019, doi: 10.1109/TVLSI.2019.2896776.
- [12] T. Cheng, H. Du, L. Li and Y. Fu, "LSTM-based Temperature Prediction and Hotspot Tracking for Thermal-aware 3D NoC System," 2021 18th International SoC Design Conference (ISOCC), Jeju Island, Korea, Republic of, 2021, pp. 286-287, doi: 10.1109/ISOCC53507.2021.9613862.