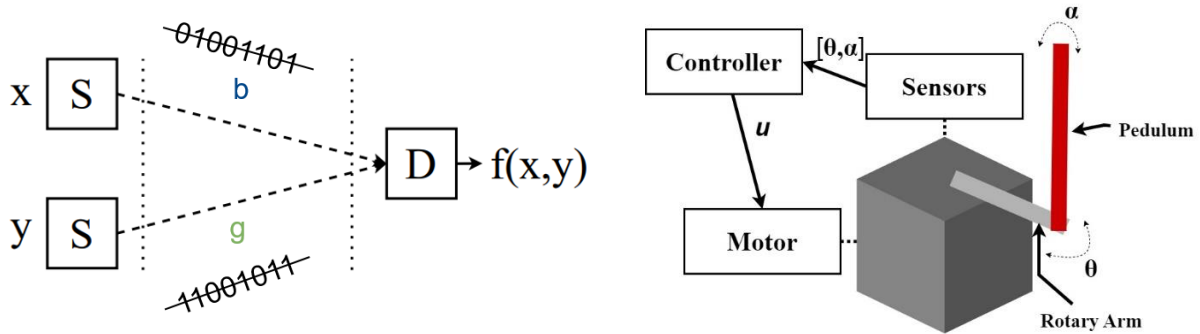


Functional Compression for Practical Networked Control Applications



Background:

Functional compression (FC) is a novel communication paradigm that aims to reduce communication overhead by transmitting only the necessary bits of information to achieve the desired goal. FC is a post-Shannon communication paradigm based on the idea of goal-oriented communication. The compression gains of this approach are potentially more significant than traditional compression techniques because the encoders transmit only the necessary information to compute the function and not to reconstruct the original sensor data. The system achieves the same goal with fewer bits, but the decoder cannot reconstruct the sensor data; it can only compute the goal function.

Tasks:

- Gain an understanding of the fundamentals of FC.
- Understand the underlying different types of graph coloring encoding algorithms.
- Identify a potential network-based control use case.
- Implement FC over the local network for the control use case (Preferred language: Python).
- Perform the measurements (i.e., latency, compression rate, and control cost) and sum up your results.
- Discuss the limitations and the future work.
- Prepare a report

Keywords:

Functional compression, goal-oriented communication, graph coloring, post-Shannon.

Contact:

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- Languages: English

Resources:

[1] S. Feizi and M. Medard, "On network functional compression," IEEE Transactions on Information Theory, vol. 60, no. 9, pp. 5387–5401, 2014.

- [2] V. Doshi, D. Shah, M. Medard, and M. Effros, “Functional compression through graph coloring,” *IEEE Transactions on Information Theory*, vol. 56, no. 8, pp. 3901–3917, 2010.
- [3] S. Rezwan, J. A. Cabrera, and F. H. P. Fitzek, “Network functional compression for control applications,” in *2022 International Conference on Electrical, Computer, Communications and Mechatronics Engineering (ICECCME)*, 2022, pp. 1–6.
- [4] S. Rezwan, H. Wu, J. A. Cabrera, G. T. Nguyen, M. Reisslein, and F. H. P. Fitzek, “cxr+ voxel-based semantic compression for networked immersion,” *IEEE Access*, vol. 11, pp. 52 763–52 777, 2023.