FORCE DIRECTED SCHEDULING

Hardware Software Codesign

Summer Semester 2024

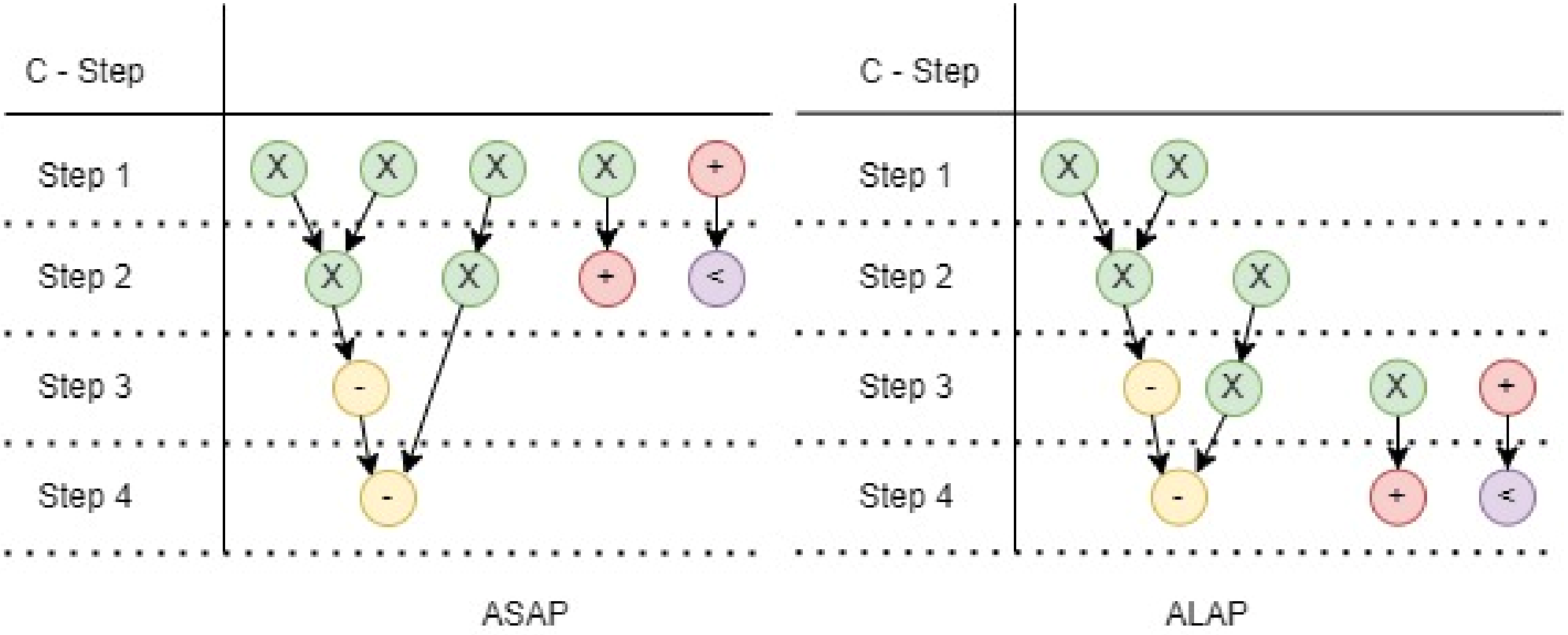
By : Pisula Guruge

MOTIVATION

FORCE DIRECTED SCHEDULING

- Minimize total energy consumption.
- Maintain resource limits and task dependencies.
- Reduce the number of processors used.
- Decrease simultaneous execution levels.
- Maintain same execution duration. [1]

ASAP AND ALAP SCHEDULING

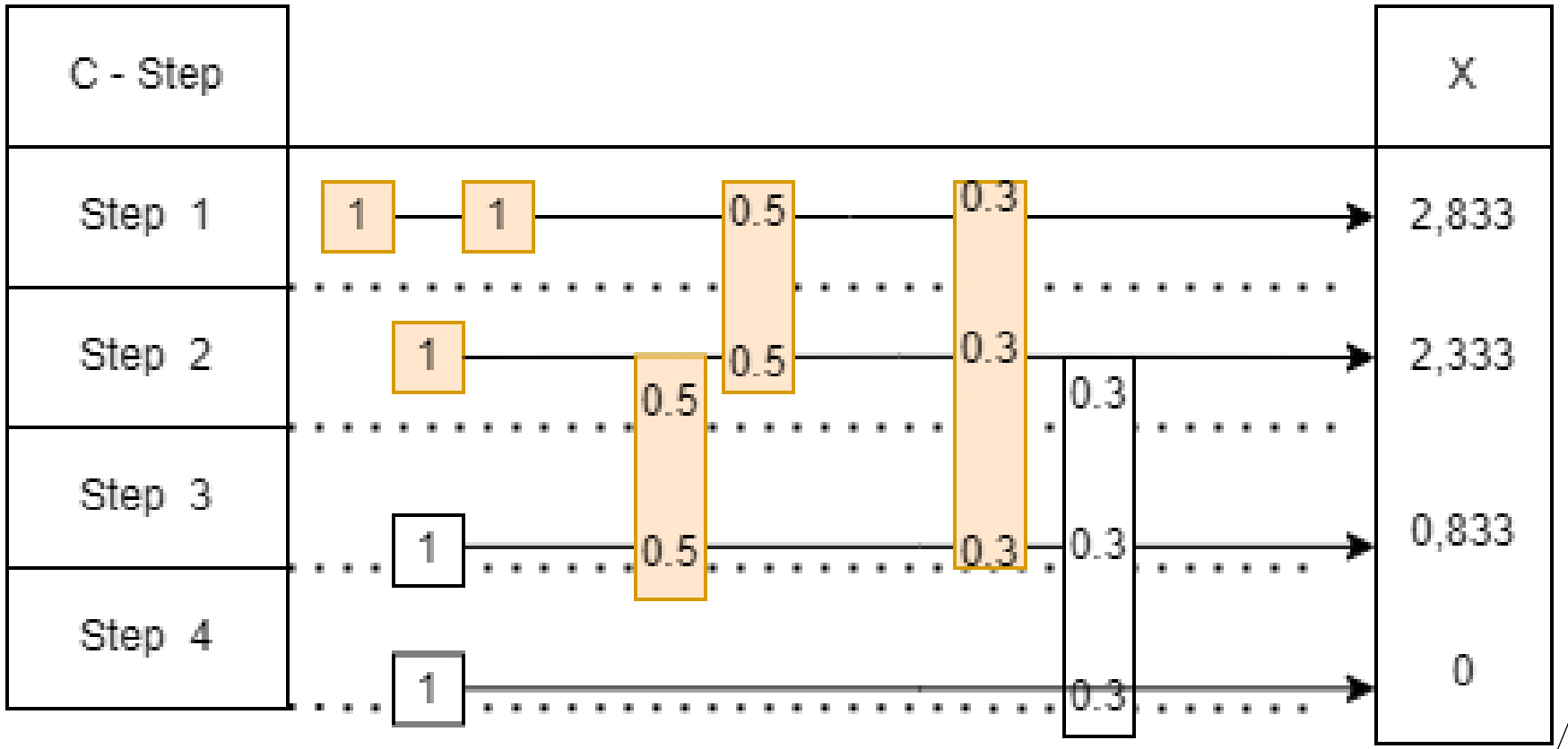


Based on [1]

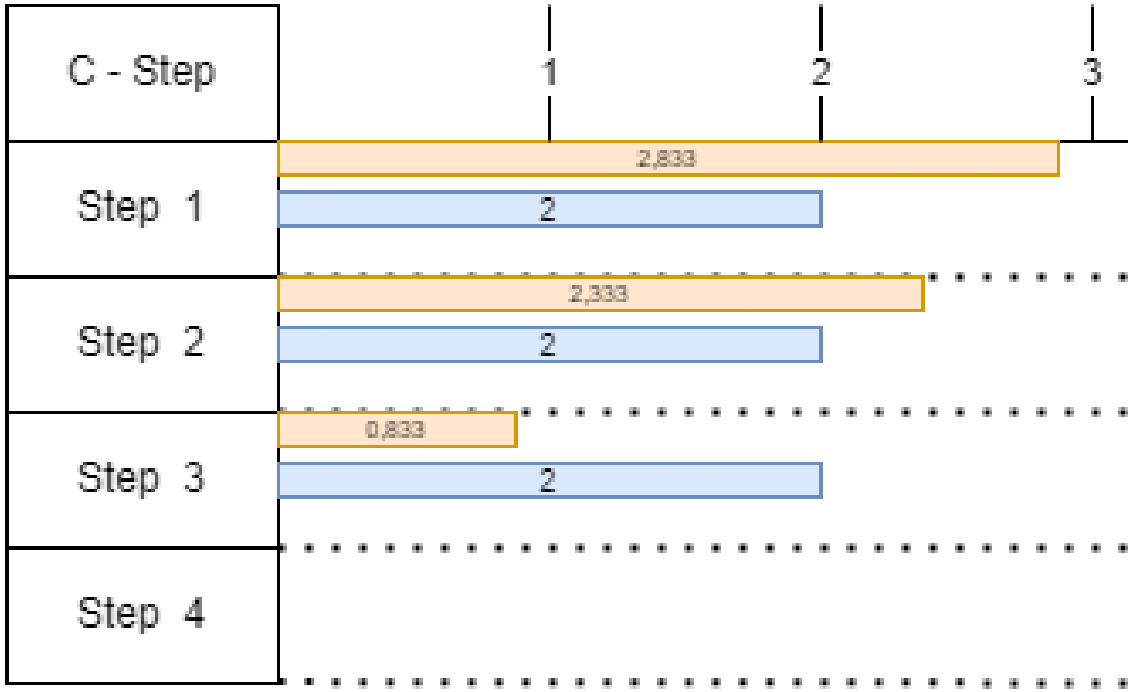
HOOKE'S LAW

- Hooke's Law states that the force required to extend or compress a spring is proportionate to the distance extended or compressed.
- Hooke's law is represented by the equation $F=-kx$.

DIAGRAM FLOW GRAPH(DFG)



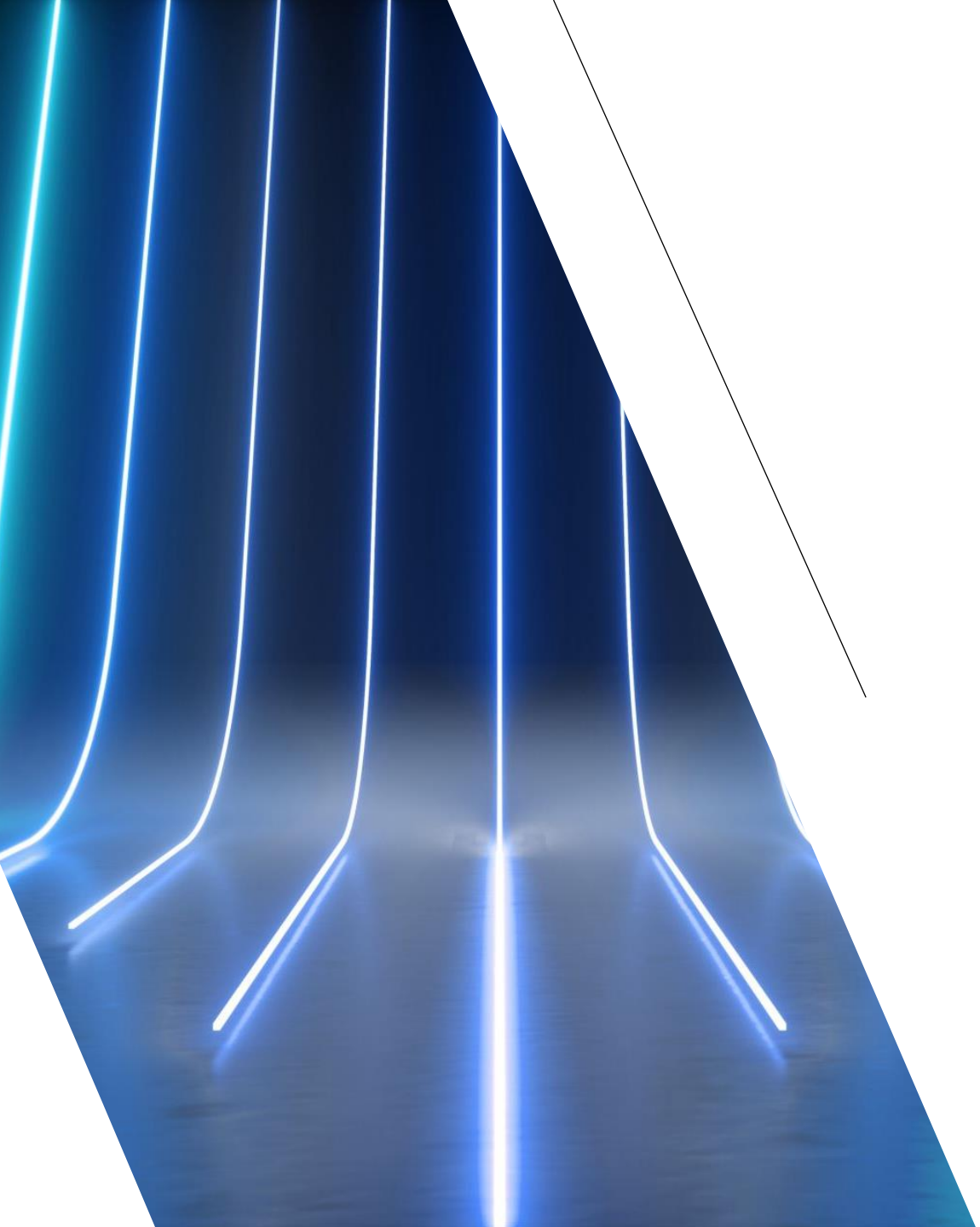
COMPARISON OF INITIAL AND FINAL DISTRIBUTION GRAPHS



- In C-Step 1 : Force = 2.833*(1-0.5) + 2.333*(0-0.5) = + 0.25
- In C-Step 2 : F = 2.833*(0-0.5) + 2.333*(1-0.5)= - 0.25

- In C-Step 2 : 2.333*(1-0.5) + 0.833*(0-0.5) = + 0.75
- In C-Step 3 : 2.333*(0-0.5) + 0.833*(1-0.5) = - 0.75

- In C-Step 1 : F = 2.833*(1-0.33) + 2.333*(0-0.33) + 0.833*(0-0.33) = + 0.853
- In C- Step 2 : F =2.833*(0-0.33)+2.33*(1-0.33)+0.833*(0-0.33)=0.351



SUMMARY

• Optimization: FDS minimizes conflicts and enhances resource utilization through force simulation.

• Flexibility: Allows dynamic adjustments to accommodate changes and uncertainties.

• Visualization: Provides real-time visual adaptation for better analysis and response.

REFERENCES

[1] Lee, E. T., Schrage, J. B. (1974). An algorithm for scheduling independent tasks. Operations Research, 22, 458-475.

[2] Johnson, R. G. (1983). Heterogeneous parallel processing. Communications of the ACM, 26, 832-844.

[3] Brandenburg, F. Force Directed Scheduling: A Survey. Journal of Scheduling, 15(1), 2012, pp. 3-24.

[4] Liu, J. W. S. (2000). Real-Time Systems. Prentice Hall.

[5] Kress, R., Thiele, L. (2002). Models and Algorithms for Embedded Real-Time Systems. Springer.

[6] P. G. Pauline and J. P. Knight, ”Force-Directed Scheduling in Automatic Data Path Synthesis,” 24th ACM/IEEE Design Automation Conference, Miami Beach, FL, USA, 1987, pp.195-202, doi: 10.1145/37888.37918.

[7] Scheduling Algorithms for High-Level Synthesis Zoltan Baruch Computer Science Department, Technical University of Cluj-Napoca , URL - http://users.utcluj.ro/ baruch/papers/ Scheduling-Algorithms.pdf

[8] Micheli, Giovanni. Synthesis and Optimization of Digital Circuits. McGraw-Hill Professional, 1994.