"CPS Foundations in Computation and Communication"
## Small: RUI – Mina Sartipi (PI) & Stephen Craven (Co-PI)
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Summary – Novel computation and communication schemes are being developed to reduce energy consumption and improve timing predictions.

Computation

Problem – Modern processor architectures complicate timing analysis. Real-time scheduling improves with accuracy of code execution time estimates.

Approach – Instructions from different threads interleaved in pipeline. Data hazards removed, eliminating branch prediction, pipeline stalls, etc., creating a <u>Precision Timed (PRET) µP</u>.

F	D	E1	E2	M	W
A	B	C	D	E	F
F	A	B	C	D	E

Time
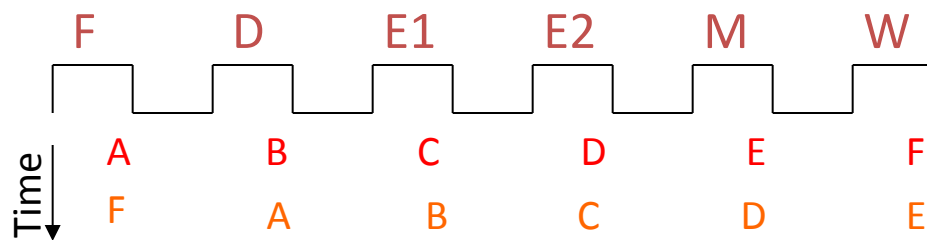
Results – 6-stage pipeline eliminates hazards and multi-cycle instructions. FPGA implementation yields 2x speed-up over conventional processor with minimal area increase.

Communication

Problem – A simple, energy-efficient, and reliable communication scheme is required for relaying information between CPS nodes in CPS networks.

Approach – Combine the best of multicasting with the best of distributed source coding (DSC) which incorporates and uses ideas from rateless coding. Using the reliable TCP multicasting channel to deliver data through common links and build up multiple multicasting paths. The construction of multiple paths maximizes throughput of common paths while minimizing the total cost of each path.

Results – The introduced multicast algorithm outperforms the existing algorithms over lossy channels in terms of total number of required transmissions per transmitted packet.