

Dynamic Timing Analysis

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MPI-INF

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Reference



J. C. Ebergen, S. Fairbanks, and I. E. Sutherland.

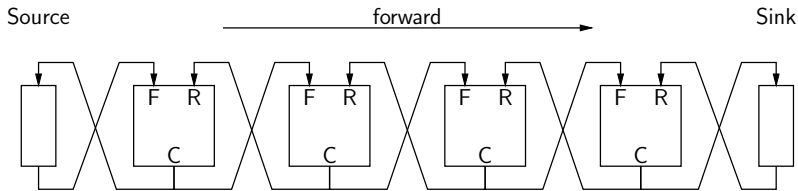
Predicting performance of micropipelines using charlie diagrams.

In Advanced Research in Asynchronous Circuits and Systems, 1998. Proceedings. 1998 Fourth International Symposium on, pages 238–246, Mar 1998.

What happened so far

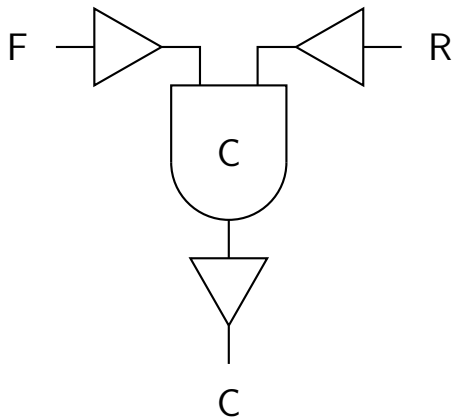
- ▶ We have analyzed circuits and their behavior.
- ▶ We have seen the dependence of the delay on their structure and input.
- ▶ So far only static analysis.

Micro-pipeline

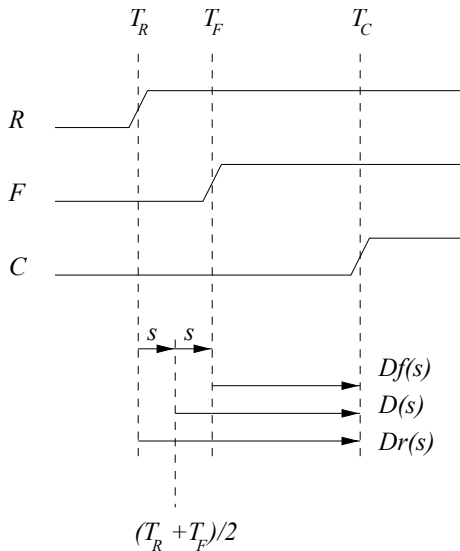


- ▶ The source generates data items/requests.
- ▶ The requests trigger the next block at the *Forward* input.
- ▶ The requests get acknowledged by each stage.
- ▶ The requests bubble through the pipeline from one stage to the next.
- ▶ The sink consumes all data items.

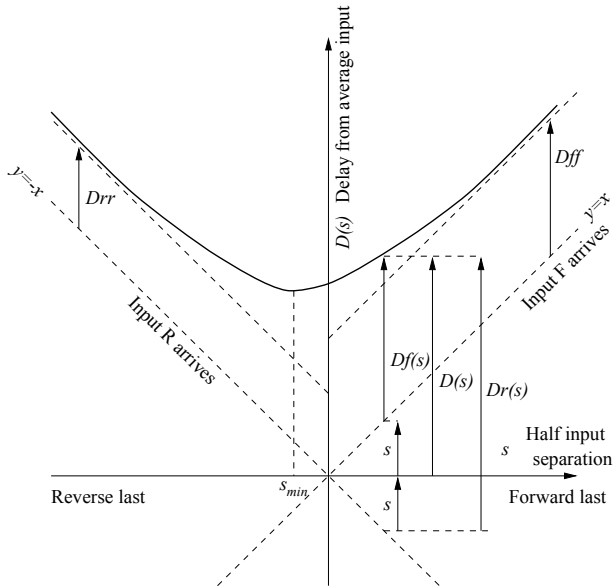
Micro-pipeline - Müller C-Element



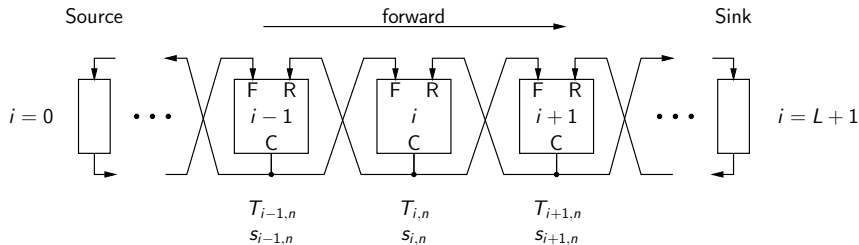
Timing of the Müller C-Element



The Charlie Diagram

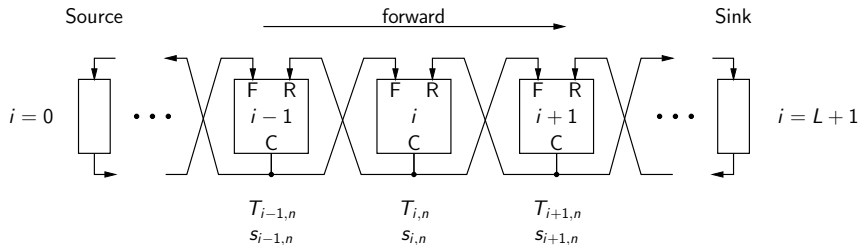


Signal Propagation in the Micro-pipeline



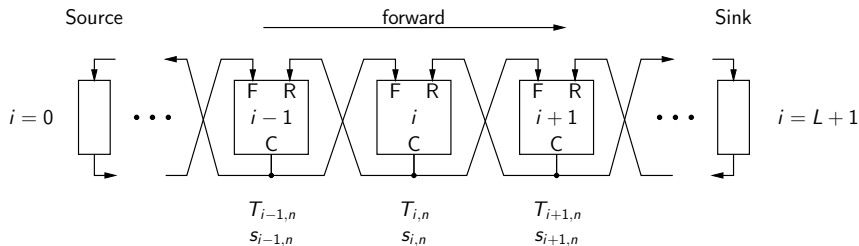
- ▶ L stages long pipeline.
- ▶ $s_{i,n}$ is the half separation time of stage i at data packet n .
- ▶ $T_{i,n}$ is the time when stage i generates an output for packet n .

Signal Propagation in the Micro-pipeline



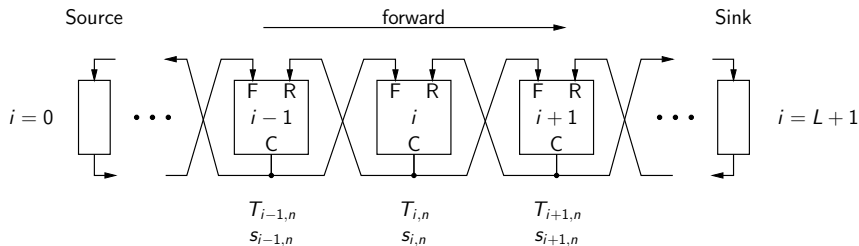
- ▶ $2 * s_{i,n} = T_{i-1,n} - T_{i+1,n-1}$
- ▶ $Df(s_{i,n}) = T_{i,n} - T_{i-1,n}$
- ▶ $Dr(s_{i,n}) = T_{i,n} - T_{i+1,n-1}$

Signal Propagation in the Micro-pipeline



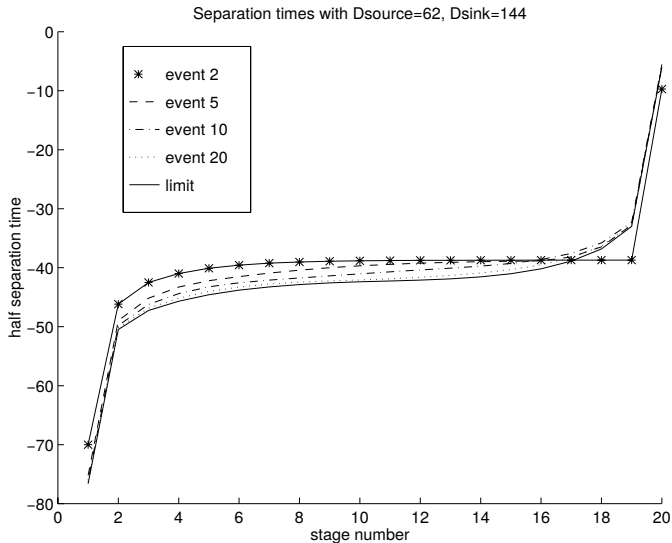
- ▶ $T_{i,n+1} - T_{i,n} = Dr(s_{i-1,n+1}) + Df(s_{i,n+1})$
- ▶ $T_{i,n+1} - T_{i,n} = Dr(s_{i+1,n}) + Df(s_{i,n+1})$
- ▶ $Dr(s_{i-1,n+1}) + Df(s_{i,n+1}) =$
 $Dr(s_{i+1,n}) + Df(s_{i,n+1})$

Signal Propagation in the Micro-pipeline

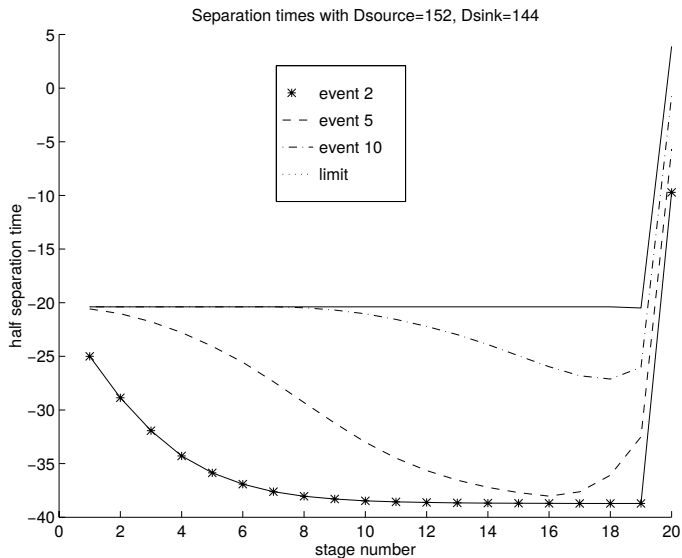


- ▶ $Dr(s_{i-1,n+1}) + Df(s_{i,n+1}) = Dr(s_{i+1,n}) + Df(s_{i,n+1})$
- ▶ $Dr(s) - Df(s) = 2s$
- ▶ $Dr(s_{i-1,n+1}) - Dr(s_{i+1,n}) = 2s_{i,n+1}$

Separation for Self-Limited Pipeline



Separation for Source-Limited Pipeline



Separation for Sink-Limited Pipeline

