A Correctness Criterion for Asynchronous Circuit Validation and Optimization

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Abstract.   *In order to reason about the correctness of asynchronous circuit implementations and specifications, Dill has developed a variant of trace theory [1]. Trace theory describes the behavior of an asynchronous circuit by representing its possible executions as strings called "traces". A useful relation defined in this theory is called* conformance, *which holds when one trace specification can be safely substituted for another. We propose a new relation in the context of Dill's trace theory, called* strong conformance. *We show that this relation is capable of detecting certain errors in asynchronous circuits that cannot be detected through conformance. Strong conformance also helps to justify circuit optimization rules where a component is replaced by another component having extra capabilities (e.g., it can accept more inputs). The structural operators of Dill's trace theory — compose, rename and hide — are shown to be monotonic with respect to strong conformance. Experiments are presented using a modified version of Dill's trace theory verifier which implements the check for strong conformance.*