

Compositionality in Synchronous Data Flow: Modular Code Generation from Hierarchical SDF Graphs*

(Poster Abstract)

Stavros Tripakis, Dai Bui, Bert Rodiers and Edward A. Lee
Department of Electrical Engineering and Computer Sciences
University of California, Berkeley

stavros, daib, eal@eecs.berkeley.edu, bert.rodiers@gmail.com

Abstract

A widespread model of computation, particularly suited for signal processing applications, which are often a key element in cyber-physical systems, is Synchronous (or Static) Data Flow (SDF). But hierarchical SDF models are not compositional: a composite SDF actor (e.g., actor P of Figure 1) cannot be represented as an atomic SDF actor without loss of information that can lead to deadlocks (Figure 2).

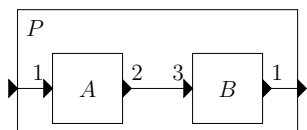


Figure 1: A hierarchical SDF graph.

To solve this problem, we propose in [1] *DSSF profiles* (Figure 3). *DSSF* (Deterministic SDF with Shared FIFOs) forms a compositional abstraction of composite actors that can be used for modular compilation. We provide algorithms for automatic synthesis of non-monolithic *DSSF* profiles of composite actors given *DSSF* profiles of their sub-actors. We show how different tradeoffs can be explored when synthesizing such profiles, in terms of size of the generated profile versus reusability (preserving informa-

*This work is supported by the Center for Hybrid and Embedded Software Systems (CHESS) at UC Berkeley, which receives support from the National Science Foundation (NSF awards #0720882 (CSR-EHS: PRET) and #0720841 (CSR-CPS)), the U.S. Army Research Office (ARO #W911NF-07-2-0019), the U.S. Air Force Office of Scientific Research (MURI #FA9550-06-0312), the Air Force Research Lab (AFRL), the State of California Micro Program, and the following companies: Agilent, Bosch, Lockheed-Martin, National Instruments, Thales and Toyota.

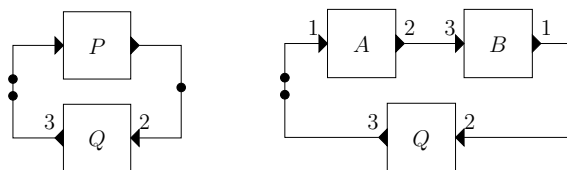


Figure 2: Using block P of Figure 1 in feedback (left); after flattening (right).

tion necessary to avoid deadlocks) as well as algorithmic complexity. We show that our method guarantees maximal reusability and report on a prototype implementation in Ptolemy II.

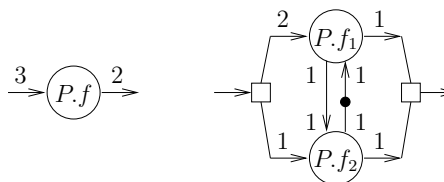


Figure 3: Two profiles for actor P of Figure 1.

References

- [1] S. Tripakis, D. Bui, B. Rodiers, and E.A. Lee. Compositionality in Synchronous Data Flow: Modular Code Generation from Hierarchical SDF Graphs. Technical Report UCB/EECS-2009-143, EECS Department, University of California, Berkeley, Oct 2009. <http://www.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-143.html>.