Compositionality in Synchronous Data Flow:
Modular Code Generation from Hierarchical SDF Graphs∗
(Poster Abstract)

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

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

References