Sequentiability and Determinacy for Reactive Systems

A Sequentially Constructive Circuit Semantics for Esterel

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Berry Constructive Circuits (BCC)

module OffOn:
output S, T, U;
present S then emit T end;
emit S;
present S then emit U end

Constructive coherence law:
A signal is present/absent iff it must/cannot be emitted
Berry Constructive Circuits (BCC)

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GO-
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Proposal

Recall:
Constructive coherence law:
A signal is present/absent iff it must/cannot be emitted
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A signal is present/absent iff it must/cannot be emitted

**Sequentially** Constructive Coherence Law:
A signal is present/absent iff it must/cannot be emitted concurrently or sequentially preceding

We say that an emit E is **SC-visible** to a present test P if:
1) E is concurrent to P or
2) E sequentially precedes P
SC-Visibility in Circuit Construction

P; Q; [R || S]

P Q R S

E'
E

SC-Visibility in Circuit Construction

P; Q; [R || S]

P Q R S

E'
E

Ec'
Ec
SC-Visibility in Circuit Construction

\[ P ; Q ; [ R \parallel S ] \]

Circuit Interface

\[ P \]

- E  
- E' 
- GO SEL 
- RES k0 
- SUS k1 
- KILL k2 

Berry Constructive Circuit
Circuit Interface

\[ P \]

- E
- E'
- GO
- RES
- SUS
- KILL

\text{BCC}
Berry Constructive Circuit

emit s

GO
E'
k0

BCC

Circuit Interface

\[ P \]

- Ec
- Ec'
- Es
- Es'

\text{SCC}
Sequently Constructive Circuit

emit s

GO
Es'Ec'
k0

SCC
present s then P else Q

present s then P else Q

P ; Q

P ; Q
Formal Semantics and Conservativeness

Behavior of BC circuit with SC-visibility evaluation
⇒ Behavior of SC circuit with BC evaluation
(Proof sketch in Technical Report 1801)

Evaluation Relation:
\[ C, I, R \vdash e \leftrightarrow_\pi b \]

Evaluation Rules:
\[ \exists w \leftarrow_I e \in C. \pi \not\models l \land e \leftrightarrow_\pi \bigoplus l \frac{1}{PRES(\pi, l)} \leftarrow_\pi 1 \]
\[ \forall w \leftarrow_I e \in C. \pi \not\models l \Rightarrow e \leftrightarrow_\pi \bigoplus l \frac{0}{ABS(\pi, w)} \leftarrow_\pi 0 \]

Formal Semantics and Conservativeness

\[ T[G1] \iff GO \land S[G2] \]

Weak Unemit Circuit

\[ Es \quad \text{Go} \quad \text{Es'} \]

\[ Go \quad k0 \]

Formal Semantics and Conservativeness

\[ T[G1] \iff GO \land S[G2] \]

\[ G1 \preceq G2 \implies S[G2] \iff 0 \]

\[ \text{Go} \quad \text{G1} \quad \text{G2} \quad \text{Done} \]