Refinement of Structured Specifications (1991)

for all $\varphi \in \Phi$, $SP \vdash \varphi$

$SP \vdash \langle \text{Sig}(SP), \Phi \rangle$

$SP \vdash SP_1$

$SP \vdash SP_2$

$SP \vdash SP_1 \cup SP_2$

$SP' \text{ hide via } \sigma \vdash SP$

$SP' \vdash SP \text{ with } \sigma$

$SP' \vdash SP \text{ hide via } \sigma$

Clarifications: $	ext{INS} = \langle \text{Sign}, \text{Sen}: \text{Sign} \rightarrow \text{Set}, \text{Mod}: \text{Sign}^\to \rightarrow \text{Cat}, \{\models_{\Sigma} \subseteq \text{Mod}(\Sigma) \times \text{Sen}(\Sigma) : \Sigma \in \text{Sign} \rangle$ is an institution that defines the logical system used for specifications, and $SP$, $SP_1$, $SP_2$, $SP'$ and $SP$ are structured specifications over $	ext{INS}$. Structured specifications in $	ext{INS}$ are built from basic specifications $\langle \Sigma, \Phi \rangle$ where $\Sigma \in \text{Sign}$ and $\Phi \subseteq \text{Sen}(\Sigma)$, the union of $\Sigma$-specifications $SP_1 \cup SP_2$, the translation “$SP \text{ with } \sigma$” of $SP$ along a signature morphism $\sigma: \Sigma \rightarrow \Sigma'$, and hiding “$SP \text{ hide via } \sigma$” for hiding the symbols in $SP$ not occurring in the image of $\sigma: \Sigma \rightarrow \Sigma$. $\text{Sig}(SP)$ is the signature of $SP$ and $\text{Mod}(SP) \subseteq \text{Mod}(\text{Sig}(SP))$ is the class of models of $SP$. A signature morphism $\sigma: \text{Sig}(SP) \rightarrow \text{Sig}(SP')$ is a specification morphism $\sigma: SP \rightarrow SP'$ if for every $M' \in \text{Mod}(SP')$, $\text{Mod}(\sigma)(M') \in \text{Mod}(SP)$. Then $\sigma$ admits model expansion if $\text{Mod}(\sigma): \text{Mod}(SP') \rightarrow \text{Mod}(SP)$ is surjective. The judgement $SP \vdash \varphi$ is entailment for structured specifications which is required to be sound: $SP \vdash \varphi$ implies $M \models_{\text{Sig}(SP)} \varphi$ for every $M \in \text{Mod}(SP)$.

The judgement $SP \vdash SP'$ is meant to capture that $SP$ refines (entails) $SP'$, that is, $\text{Sig}(SP) = \text{Sig}(SP')$ and $\text{Mod}(SP) \subseteq \text{Mod}(SP')$.

History: The first proof systems for refinement of structured specifications were given by Farrés-Casals [1] and Wirsing [2]. The above presentation can be found in [4], Sect. 9.3.

Remarks: The calculus is sound; it is complete if the underlying entailment system for structured specifications is complete [2][4]. [3] provides additional rules for observability operators to support refinement by observational abstraction.


Entry 29 by: Rolf Hennicker, Donald Sannella, Andrzej Tarlecki, Martin Wirsing