The META-Frame: An Environment for Flexible Tool Management

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META-Frame is designed for the flexible management of a *large* library of tools. It supports the semi-automatic construction of application-specific tools from natural language-like 'profiles', as well as the inclusion of new tools into the library, in a way which does not require much expertise. Special care has been taken in the design of an adequate, almost natural-language specification language, a user-friendly graphical interface, a hypertext based navigation tool, the repository management, and in the automation of the synthesis process. This application-independent core has a firm theoretical basis: the synthesis is conceptually based on a model construction algorithm for a linear time temporal logic and supports an advanced form of Meta-level Intelligent Software Synthesis (MISS [SFCM94]). Altogether, META-Frame supports a full synthesis lifecycle (Figure 1) by

1. providing a flexible specification language that captures *local* properties like taxonomic component descriptions and type conditions, and *global* constraints fixing ordering, precedence, eventuality and conditional occurrence,
2. transforming specifications automatically into executable programs by means of a *minimal model generator* for the underlying modal logic (cf. [StMF93]), determining the set of all legal tool compositions satisfying these constraints, which are graphically displayed,
3. supporting the investigation of the alternative legal tool compositions via a hypertext system, which helps the user navigate over the synthesized tool compositions, the taxonomic structure of the repository, and the documentation and code of the tools,
4. selecting on the solution graph suitable tool compositions for direct (interpreted) execution,
5. supporting the classification of satisfactory newly synthesized tools into the repository by proposing an appropriately precomputed default taxonomic classification. These classifications are sufficient for future retrieval, but can also be modified by means of the hypertext system,
6. compiling selected tool compositions for a permanent inclusion in the tool repository. This supports hierarchical tool design.

The experience with META-Frame is very promising: it reveals unexpected alternative solutions and makes the understanding of the available tools and their interaction transparent. Moreover, the possibility of natural language-like specification, the hypertext support of repository navigation, the specific profiles of

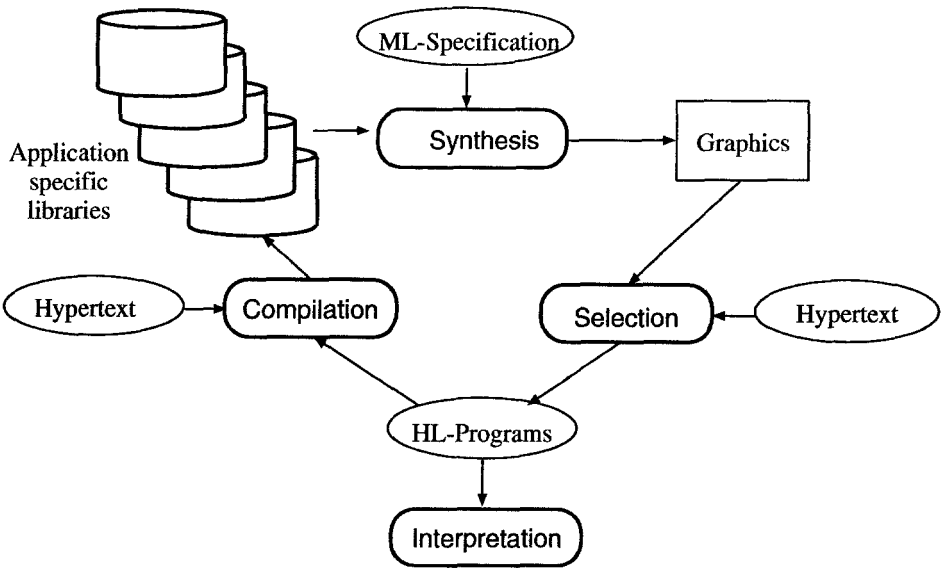

Fig. 1. The META-Frame synthesis lifecycle

the stored tools, and the user friendly graphical interface encourage successful experimentation without requiring much expertise. In fact, one can use META-Frame also as an educational tool to train newcomers in an application field.

As META-Frame is an open system, it can easily be extended and modified to include further tools, to realize a a highly distributed environment where tools are retrieved at need, and to cover other application domains. These properties are particularly important in emerging areas like Hardware/Software codesign, where integration of heterogeneous domains is a key point.

Applications range from the semi-automatic intelligent network programming for advanced telephone services (in cooperation with Siemens Nixdorf, Munich), over the automatic configuration of complex UNIX piping sequences for text and image processing [SFCM94], to the automatic generation of complex tools from a repository of components.

References

[SFCM94] B. Steffen, B. Freitag, A. Claßen, T. Margaria, U. Zukowski: "*Intelligent Software Synthesis in the* DaCapo *Environment,*" 6th Nordic Worksh. on Programming Theory, Aarhus (DK), Oct. 1994, BRICS Rep. N.94/6.

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