**High-speed multi-rate FIR filter generator**

**What is hsfir?**

hsfir is a software package for the generation of high-speed FIR filters. Filters are generated either on direct form or on transposed direct form. Additionally, on direct form the possibility to utilize the symmetry of linear-phase filters is supported. For each structure, the filter consists of two parts: a partial product generation part, and a carry-save adder tree pipelined to meet a pre-defined maximum depth. The software package consists of two parts:

The filter optimization part, which generates an internal representation of the filter architecture from a given impulse response, structure, arithmetic, speed and wordlength requirements. Additionally, the amount of required hardware resources is computed.

The VHDL code generation part, which generates synthesizable VHDL code from a given internal filter architecture representation. The code uses full adders, half adders, and register primitives.

**Authors**

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**News**

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| **2010-06-02** | hsfir-0.2 released. New features include general multi-rate FIR structures and support for adder sharing. |
| **2009-01-12** | hsfir-0.1 released. |

**Features**

hsfir has the following features:

* Carry-save tree realization through Wallace, Dadda, and Reduced Area heuristics.
* Carry-save tree realization through integer linear programming-based bit-level optimization using the GNU Linear Programming Kit and SCIP.
* Generate multi-rate structures with K input branches and N output branches.
* Unsigned and signed data representations.
* Binary and signed-digit coefficient representations.
* Generation of bit-level optimized VHDL code and bit- and delay-true high-level reference VHDL code.
* Generation of testbench and stimuli to verify correctly generated code.

**Supported platforms**

hsfir is written in MATLAB, and has been tested on Linux. It should also work on Windows.

**License**

All the code in this package is distributed under the GNU General Public License version 3:

If hsfir is used in any scientific publication, please include a reference to [1].

If the integer linear programming optimization is used, the SCIP license additionally applies. See [the SCIP license](http://scip.zib.de/licence.shtml) for details.

**Download**

* [hsfir-0.2.tar.gz](file:///Volumes/LapptopG4/TEMPTOOLBOX/HS_FIR/hsfir-0.2.tar.gz) in gzipped tar format.
* [hsfir-0.1.tar.gz](file:///Volumes/LapptopG4/TEMPTOOLBOX/HS_FIR/hsfir-0.1.tar.gz) in gzipped tar format.

**Links**

* [The authors' paper](http://www.springerlink.com/content/tw41673711244025/fulltext.pdf) describing the filter structures and the bit-level optimization algorithm.
* [GLPK](http://www.gnu.org/software/glpk/) (GNU Linear Programming Kit), used to formulate the integer linear programming problems
* [SCIP](http://scip.zib.de/scip.shtml) (Solving Constraint Integer Programs), the integer linear programming solver that hsfir uses.

**References**

[1] A. Blad and O. Gustafsson, "Integer Linear Programming-Based Bit-Level Optimization for High-Speed FIR Decimation Filter Architectures," *Circuits, Systems and Signal Processing - Special Issue, Low Power Digital Filters*, 21 pages, 2009. doi: 10.1007/s00034-009-9116-5.

[2] A. Blad and O. Gustafsson, "Redundancy Reduction for High-Speed FIR Filter Architectures Based on Carry-Save Adder Trees," in *IEEE Int. Symp. Circuits Syst.*, Paris, May 30-June 2, 2010.