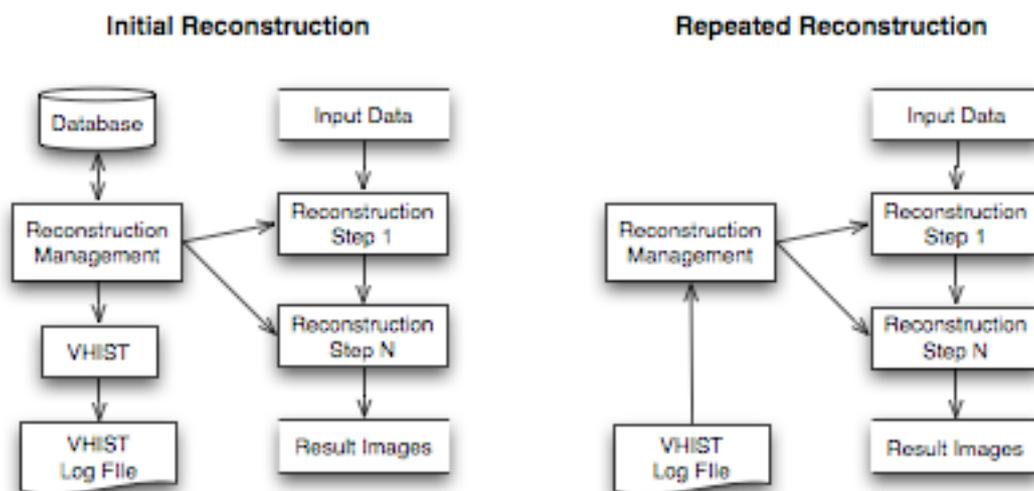


## VALIDATION AND REPRODUCIBILITY OF A PET RECONSTRUCTION SYSTEM

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Reconstruction of images from the HRRT PET scanner is a complex and lengthy process involving large input data volumes (> 10 GB) and lengthy processing (>5 hours). Processing from raw listmode files to fully reconstructed images involves 10 or more programs with a combined 300+ possible parameters, all of which may be varied. Errors may enter the processing system through data corruption during transfer between computers, or disk errors. Multiple versions of any program may be used during development, or to maintain consistency during longitudinal studies. Any of these factors may result in unpredictable and possibly undetected changes to the resultant images, and complicate reproduction of the reconstruction. We have developed a database-backed software system to manage reconstruction of HRRT PET images in a busy academic brain research centre performing up to four dynamic 90-minute scans per day. It performs three main functions: process automation, file verification, and reproducibility through workflow logging. Automation of reconstruction with high-level control of major options (such as span-number and software version) is performed by Perl programs which generate command strings for the programs performing each reconstruction step. File names are created by a deterministic algorithm based on scan and subject details stored in the database. The management system performs checking of each step. Verification of file integrity is ensured by checksum calculation after any operation, such as network transfer or disk copy, that may fail or cause corruption. The checksum and modification time of each file are stored in the database to avoid repeated checksum calculations on undisturbed files. Reproducibility of a reconstruction workflow is achieved by storing in a structured log file all parameters passed to reconstruction programs, along with the checksum of the program itself and of its input files. This log file is created by the VHIST program (Max Planck Institute) which receives as input a formal description of all program parameters, as the command strings are generated. Since the log file contains all information input to the reconstruction system, it captures the system's complete state and may be used as the sole information source for an exact repeated reconstruction. This system provides an automatic, robust and flexible method to perform HRRT PET reconstruction under varying experimental conditions. Exact reproducibility of complex reconstruction processes is ensured by recording and re-using all parameters, inputs, and signatures of key files.



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