- test the algorithms with expected and non-expected environment conditions
- do tests which are impossible to plan in real environments (e.g., loose wings, engine breakdown)
- do open-loop filter-tests (Monte Carlo simulations)
- test the salvo-function
- test the weaving and terminal phase
- perform pre- and post-simulations in connection with test firings

Our main advantage is that we will use identical missile system SW, both on the target processors and in SIMEN without changes except recompilation. The fact that the missile system SW is developed within the simulation environment reduces the development cost and technical risk of the project. To be able to port the missile system SW from host to target processor, we are developing a special SW infrastructure for each operating system used. The purpose of the infrastructure is to allow changes on the target computer without changing the missile system SW. This is done by encapsulating the implementation of the operating system functionality (e.g., communication method, timers, task distribution) from the missile system SW.

The systems message sequences are fully controlled by the simulator, and therefore all simulations are repeatable when executed with the same models and the same simulation input. Since the sequences are controlled, the simulations can be executed in real time, and slower or faster than real time dependent on the complexities of the models.

There will exist several versions of each mathematical model (ideal, simple and complex) which can be configured to fulfil different simulation needs. The models have to be as real as possible at every step in the development phase. Therefore, the mathematical models will be updated continuously during the project with measured data from, for example, wind tunnel tests, separate sensor/actuator tests, environmental tests and test firings.

4. HARDWARE-IN-THE-LOOP (HWIL) SIMULATION

In HWIL simulation, the hardware replaces mathematical models and allows us to test actual missile subsystems under closed- or open-loop conditions. Hence, on an early basis, we can test the HW interfaces and the real-time capabilities of the system.

In SIMEN there are several HWIL test configurations with different purposes.

4.1 Lab tests

The first step in our HWIL test is to port the missile system SW to the target computers. Some or all of the missile system SW executes on the target computer, while the mathematical models execute on the simulation computer or a VME-based rack (SIMEN rack) to generate the correct stimuli to the target SW.

The second step is to gradually substitute some of the simulation models with actual missile actuators or sensors. These simulations claim real-time execution for the overall simulation system. HW or logical mismatch between missile system components can then be discovered and fixed by incrementally integrating the different HW components. In addition, the real-time capability of the system can be examined and tuned.

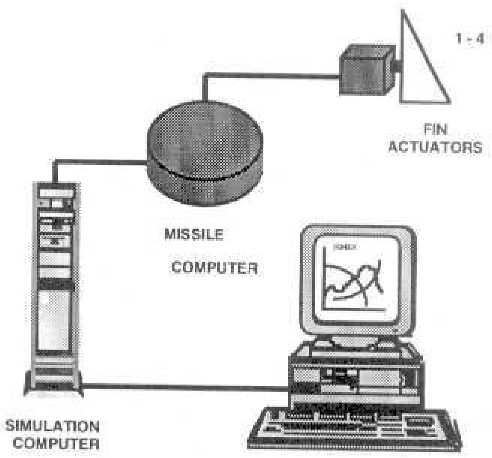

Figure 4.1 HWIL simulations, lab tests

4.2. POD flights

Some of the missile system HW demands high g-movements (e.g., inertial measurement unit (IMU)) or real environment (e.g., IR seeker) to run a proper sensor test. In order to achieve this, we will instrument a fighter aircraft fuel tank/pod with missile system components and SIMEN equipment, and fly appointed manoeuvres while recording the sensor data. These data will then be used "as is" in open-loop lab tests and to calibrate our models for future numerical simulations.