Star Tracker Concept

Two operation modes:
- Lost-in-space mode (slow)
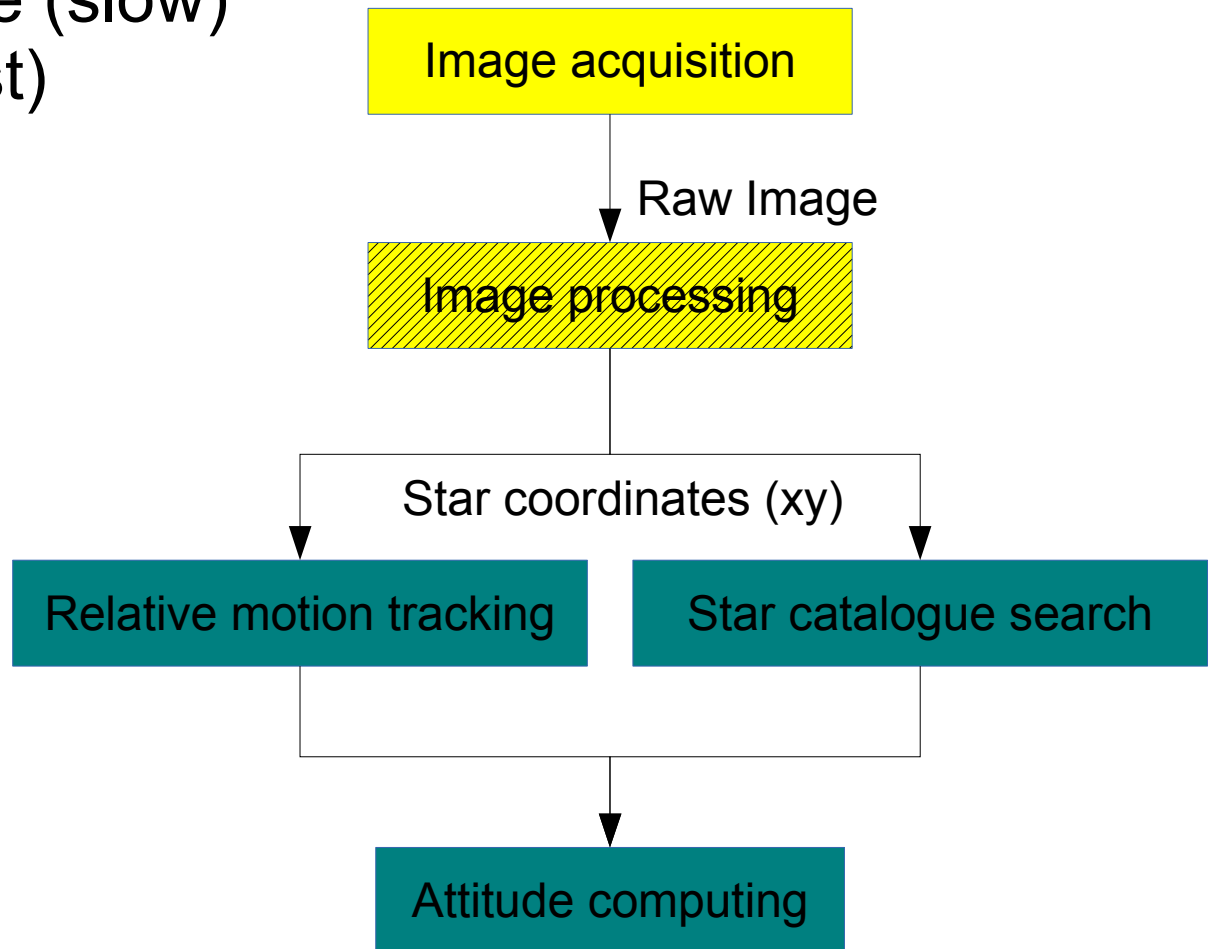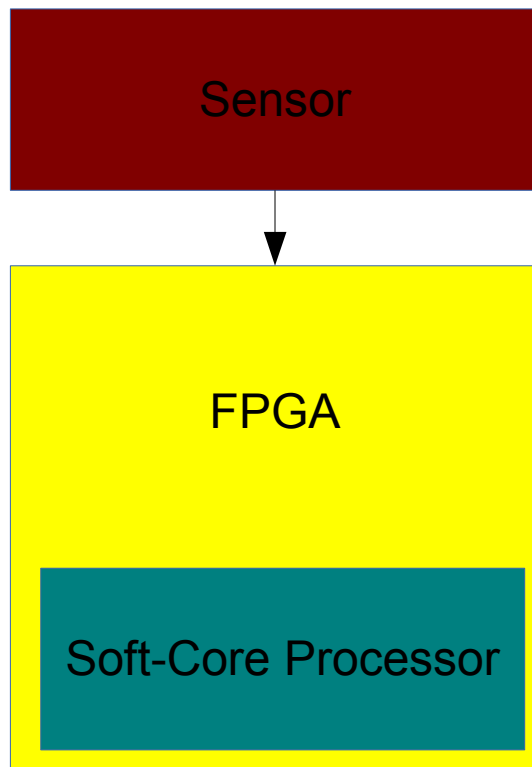- Tracking mode (fast)

Image acquisition and processing

4 MPixel Sensor
    - large data

Hardware implementation with software additions:
    - parallel computing
    - pipelining
    - lower energy consumption
    - scalability
    - high performance

Processing steps:

- Image correction:
    - Dark frame subtraction
    - Lens correction

- Star detection (acquisition of xy coordinates):
    - Image thresholding
    - Formation of star clusters
    - Image centroiding (possible techniques: Weighted Sum, Maximum Likelihood Estimator)

Star tracking and attitude computing

Relative motion tracking	**Star catalogue search**

- operating on xy coordinates

- operating on celestial coordinates (requires transformation from xy coordinates)

- Pattern matching (possible techniques: Angle Matching, Spherical Triangle Pattern Matching, <u>Planar Triangle Pattern Matching</u>, Rate Matching)

- compares patterns between two frames

- preforms serach in on-board reduced star catalog (k-vector technique)

- requires preliminary knowledge of attitude
- error propagation

- no preliminary knowledge required

- Determining the attitude quaternion (possible techniques: The Predictive Attitude Determination, <u>QUEST</u>, TRIAD, The Singular Value Decomposition, The Fast Optimal Attitude Matrix)

Platform

Actual platform:
- CMOS CMV4000 (2048 x 2048 pixel)
- SOC FPGA Xilinx ZYNQ 7020 (2 x ARM Cortex A9)

Target platform:
- Space grade FPGA
- LEON microprocessor core (based on the SPARC-V8 RISC architecture, VHDL)