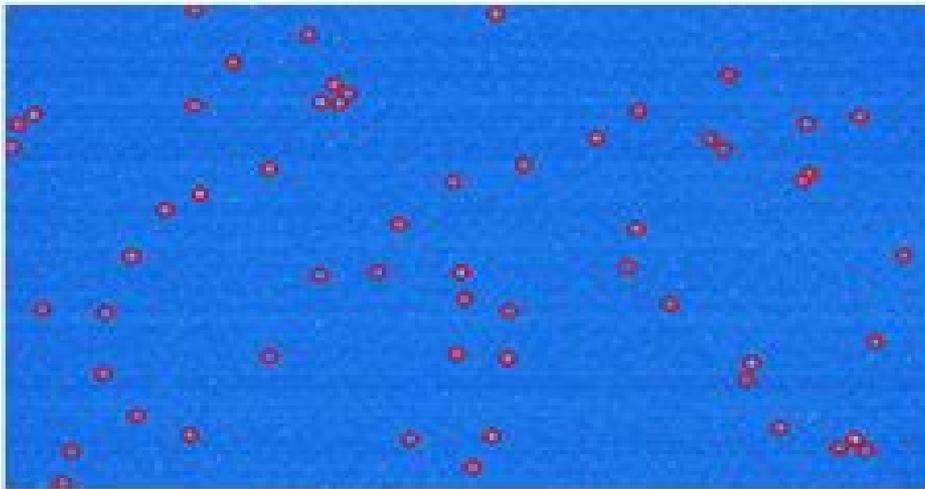
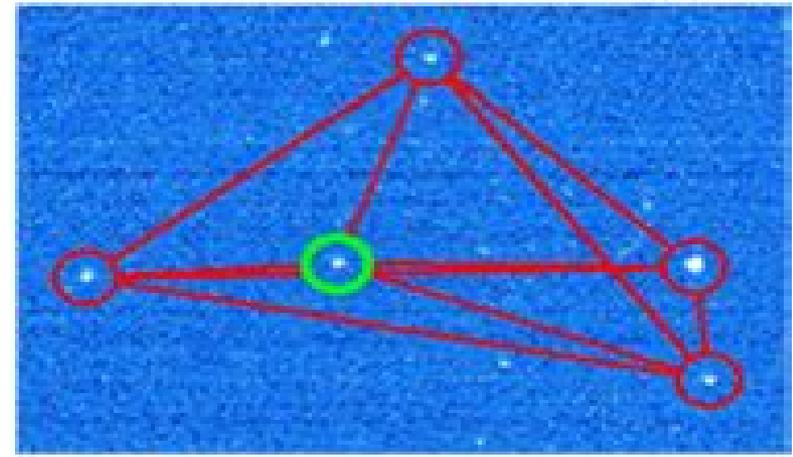


# Attitude determination using constellation

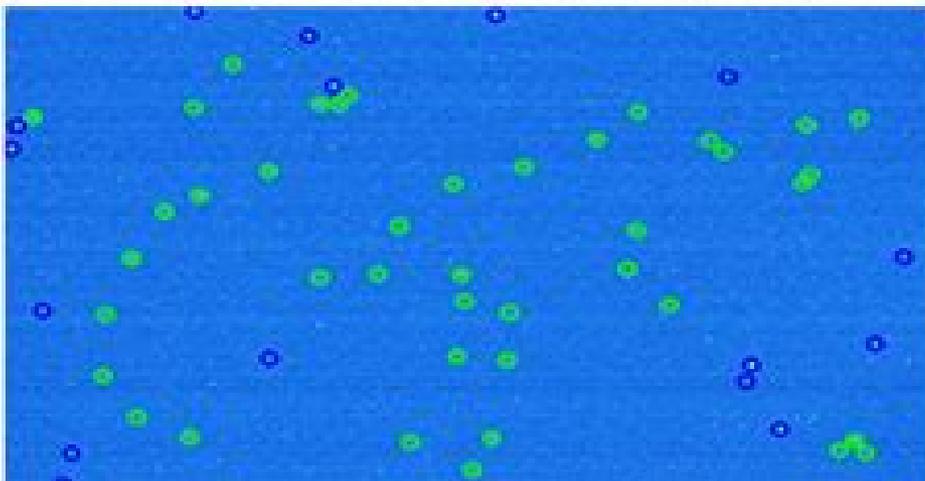
Point source extraction



Pattern matching



Star identification,  
3-axis attitude determination



# Attitude Determination Using Star Tracker Matlab Code

**SJ Ball**



## **Attitude Determination Using Star Tracker Matlab Code:**

**Proceedings of the 44th Annual American Astronautical Society Guidance, Navigation, and Control Conference, 2022** Matt Sandnas, David B. Spencer, 2024-03-30 This conference attracts GN C specialists from across the globe The 2022 Conference was the 44th Annual GN C conference with more than 230 attendees from six different countries with 44 companies and 28 universities represented The conference presented more than 100 presentations and 16 posters across 18 topics This year the planning committee wanted to continue a focus on networking and collaboration hoping to inspire innovation through the intersection of diverse ideas These proceedings present the relevant topics of the day while keeping our more popular and well attended sessions as cornerstones from year to year Several new topics including Autonomous Control of Multiple Vehicles and Results and Experiences from OSIRIS REx were directly influenced by advancements in our industry In the end the 44th Annual GN C conference became a timely reflection of the current state of the GN C ins the space industry The annual American Astronautical Society Rocky Mountain Guidance Navigation and Control GN C Conference began 1977 as an informal exchange of ideas and reports of achievements among guidance and control specialists local to the Colorado area Bud Gates Don Parsons and Bob Culp organized the first conference and began the annual series of meetings the following winter In March 1978 the First Annual Rocky Mountain Guidance and Control Conference met at Keystone Colorado It met there for eighteen years moving to Breckenridge in 1996 where it has been for over 25 years 1999 Flight Mechanics Symposium John P. Lynch, 1999 **Proceedings of a Conference Sponsored by NASA Goddard Space Flight Center at Goddard Space Flight Center**, 1999 **NASA Conference Publication**, 1999

**Attitude Determination Using Star Tracker Data with Kalman Filters** Henry D. Travis, 2001-12-01 This study adapts some established attitude determination techniques for use with star tracker measurements on satellites Other work in this area has utilized gyro measurements with star tracker updates Today's star trackers are giving measurements with accuracies of less than 6 arcseconds and are therefore of high enough fidelity to be used alone Computer simulation of a Linear Kalman Filter to process these measurements is presented The Filter uses a linear constant coefficient state matrix with the Optimal Control Law to provide negative feedback control The control law uses information developed through the equations of motion of the spacecraft in a Molnyia orbit Modifications to the Filter including glitch rejection and various covariance manipulation techniques are discussed as possible sources for performance enhancement **Fundamentals of Spacecraft Attitude Determination and Control** F. Landis Markley, John L. Crassidis, 2014-05-31 This book explores topics that are central to the field of spacecraft attitude determination and control The authors provide rigorous theoretical derivations of significant algorithms accompanied by a generous amount of qualitative discussions of the subject matter The book documents the development of the important concepts and methods in a manner accessible to practicing engineers graduate level engineering students and applied mathematicians It includes detailed examples from actual mission designs to

help ease the transition from theory to practice and also provides prototype algorithms that are readily available on the author's website. Subject matter includes both theoretical derivations and practical implementation of spacecraft attitude determination and control systems. It provides detailed derivations for attitude kinematics and dynamics and provides detailed description of the most widely used attitude parameterization, the quaternion. This title also provides a thorough treatise of attitude dynamics including Jacobian elliptical functions. It is the first known book to provide detailed derivations and explanations of state attitude determination and gives readers real world examples from actual working spacecraft missions. The subject matter is chosen to fill the void of existing textbooks and treatises especially in state and dynamics attitude determination. MATLAB code of all examples will be provided through an external website [International Aerospace Abstracts](#), 1999.

**Ground-based Attitude Determination and Gyro Calibration** Chang-Su Kim (doctor of aerospace engineering.), 2012. Some modern spacecraft missions require precise knowledge of the attitude obtained from the ground processing of on board attitude sensors. A traditional 6 state attitude determination filter containing three attitude errors and three gyro bias errors has been recognized for its robust performance when it is used with high quality measurement data from a star tracker for many past and present missions. However, as higher accuracies are required for attitude knowledge in the missions, systematic errors such as sensor misalignment and scale factor errors, which could often be neglected in previous missions, have become serious and sometimes the dominant error sources. The star tracker data have gaps and degradation caused by, for example, the Sun and Moon blocking in the field of view and data time tag errors. Thus, attitude determination based on the gyro data without using the star tracker data is inevitably required for most missions for the period when the star tracker is unable to provide accurate data. However, any gyro based attitude errors would eventually grow exponentially because of the uncorrected systematic errors of gyros and the uncorrected gyro random noises. An improved understanding of the gyro random noise characteristics and the estimation of the gyro scale factor errors and gyro misalignments are necessary for precise attitude determination for some present and future missions. The 6 state filters have been extended to 15 state filters to estimate the scale factor and misalignment errors of gyros, especially during a high slew maneuver, and the performance of these filters has been investigated. During a starless period, the inevitable drift of the EKF solutions, which are caused by the uncorrected gyro's systematic errors and the gyro random noises, can be replaced with the batch solutions, which are less affected by the data gap in the star tracker. Power Spectral Density and the Allan Variance Method are used for analyzing the gyro random noises in both ICESat and simulated gyro data, which provide better information about the process noise covariance in the attitude filter. Both simulated and real data are used for analyzing and evaluating the performances of EKF and batch algorithms.

**A Filtered Attitude Determination System for Spacecraft Measurement and Control** M. Noton, BRITISH AEROSPACE DYNAMICS GROUP BRISTOL (England) SPACE AND COMMUNICATIONS DIV., 1984. This paper refers to a collaborative project to develop an accurate attitude determination

system based on the combined use of gyros and star crossing detectors The latter are attractive for earth pointing satellites but the intermittent nature of the data introduces complications compared to star tracker systems Background is given on the hardware but the emphasis is on formulation of the estimating algorithm suitable for limited wordlength microprocessors characterization of gyro drift and estimation of overall performance both for low earth and geostationary orbits Author

**Attitude Determination: Attitude determination using a Kalman filter** James Lawrence Farrell,1966 **Fast Star Tracker Centroid Algorithm for High Performance CubeSat with Air Bearing Validation** Matthew Walter Knutson,Massachusetts Institute of Technology. Department of Aeronautics and Astronautics,2012 State of the art CubeSats such as ExoplanetSat require pointing precision for the science payload on the order of arcseconds ExoplanetSat uses dual stage control to achieve the pointing requirement Reaction wheels provide coarse satellite attitude control while a high bandwidth piezoelectric stage performs fine optical stabilization The optical sensor provides star images from which a centroiding algorithm estimates the star locations on the optical focal plane The star locations are used for both the optical control loop and satellite attitude determination The centroiding algorithm requires a short processing time to maximize the bandwidth of the fine control loop This thesis proposes a new fast centroiding algorithm based on centroid window tracking The tracking algorithm utilizes centroid data from previous image frames to estimate the motion of the optical sensor The estimated motion provides a prediction of the current centroid locations An image window is centered at each predicted star location A center of mass calculation is performed on the image window to determine the centroid location This proposed algorithm is shown to reduce the computation time by a factor of 10 with a novel air bearing hardware testbed This thesis also develops a high fidelity optical imager model in MATLAB Simulink This model can be used to test centroiding algorithms and to simulate optical systems in a spacecraft pointing simulator The model is validated with the air bearing testbed Furthermore the model is autocoded to C code which is compatible with a rapid Monte Carlo analysis framework

**Attitude Determination Using GPS Study** Ludovic Vaillon,1998 **Attitude Determination by Kalman Filtering** James L. Farrell,1966 Attitude determination using a Kalman filter J. L. Farrell,1966 **Novel Methods for Attitude Determination Using Vector Observations** Daniel Choukroun,Teĥhniyon, Makhon teĥnologi le-Yiśra'el. Faĥultah le-handasat avironotiĥah ve-ĥalal,2003 *Attitude Determination Using Static Estimation Procedures* Gail Ann Bonda,1978 *Attitude Determination Using Earth Position and Magnetic Field Vector Measurements* Brogan Page Morton,2002 The Accuracy Analysis for Difference Baseline Length Micro-satellite Attitude Determination Using GPS/Gyro System Qun Fang,Lin Chai,Junwu Wang,2002 **Attitude Determination System** International Business Machines Corporation. Federal Systems Division. Space Systems Department,1964 Attitude Determination Using Low Frequency Radio Polarisation Measurements Sean Thomas George Maguire,2015

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