Universität Stuttgart

Institut für Ingenieurgeodäsie

Structure for Lecture and Laboratories

Kinematic Measurement Systems

1 Introduction and Definitions

1.1 Definitions
1.2 Kinematic Measurement and Evaluation
1.3 Overview

2 Robot-Tachymeter

2.1 System Overview
2.2 Target Recognition and Target Tracking
  2.2.1 Automatic Rough Pointing
  2.2.2 Automatic Fine Pointing
  2.2.3 Target Tracking
2.3 Kinematic Measurements
  2.3.1 Time Delay and Synchronisation
  2.3.2 Positioning in Kinematic Mode

3 Further Kinematic Sensors

3.1 GNSS
3.2 Other Sensors

4 Modelling of Moving Objects

4.1 Dynamic System / Controlled System
4.2 Vehicle Models
  4.2.1 Steering Models
  4.2.2 Bicycle Models
  4.2.3 Track Models
4.3 Calibration of Steering Models
4.4 Prediction of Vehicles Movements
  4.4.1 Integration into Kalman Filter
  4.4.2 Different Geometric Models
  4.4.3 Integration of Future Information
4.5 Identification of Model Parameters

5 Control of Moving Objects

5.1 Closed-Loop-Systems
  5.1.1 General Characteristics
  5.1.2 Controlled Systems
  5.1.3 Typical Controllers and Controller Combinations
  5.1.4 Alignment of Controllers
  5.1.5 Control Quality
5.2 Integration of Filters and Measurement Techniques into Closed-Loop-Systems

6 Application of Guidance and Control in Construction

6.1 Closed-Loop-Systems on Construction Sites
6.2 Classification of Guidance Systems
6.3 Exemplary Applications

7 Simulator at IIGS

7.1 Simulation Concept
7.2 Realization
7.3 Exemplary Results

Laboratories:

Lab 1: Steering of Robot Tachymeters

Lab 2: Programming of Robot Tachymeter

Lab 3: Kinematic Tachymeter Measurements

Lab 5: Kinematic GNSS Measurements

Lab 5: Software Simulation for a Closed-Loop-System for Vehicles (demonstration)

Lab 6: Tachymeter Closed-Loop-System for a Construction Machine Simulator (half of the group)

Lab 7: GNSS Closed-Loop-System for a Construction Machine Simulator (half of the group)

Literature:

Anand, D.K. (1974): Introduction to control systems. Pergamon, New York - Braunschweig.

Beetz, A., Schwieger, V. (2008): Integration of Controllers and Filter Algorithms for Construction Machine Guidance. 1st International Conference on Machine Control and Guidance, Zürich, Schweiz, 24.-26-06.2008.

Chui, C.K., Chen, G. (1999): Kalman filtering with real time applications. Springer, Heidelberg – Berlin.

Gelb, G. (1994, Editor): Applied optimal estimation (Reprint 13). M.I.T. Press, Cambridge, Mass., USA.

Schwieger, V.: Challenges of Kinematic Measurements. FIG Working Week, Rome, Italy, 06.-10.05.2012.

Schwieger, V., Beetz, A.: Road Construction Machine Guidance: Overview and hardware-in-the-Loop-Simulator. Proceedings on In-ternational Conference on Innovative Technologies for an Efficient Geospatial Management of Earth Re-sources, Almaty, Kazakhstan, 18.-19.09. 2012.

Stempfhuber, W. (2006): 1D and 3D systems in machine automation. Proceedings on 3rd IAG Symposium on Geodesy for Geotechnical and Structural Engineering, Baden, Österreich.