Standardization training program
E-60 discipline: Control

Agenda

Standardization training program
E60 discipline: Control

- 10:05 - 10:15: **E60 overview**
- 10:15 - 10:35: **Control engineering handbook** (ECSS-E-HB-60A)
- 10:35 - 11:20: **Control performance, ESA Pointing Error Engineering Handbook, and ESA Pointing Error Engineering Tool** (ECSS-E-ST-60-10C, ESSB-HB-E-003, PEET)
- 11:30 - 12:00: **Star sensor terminology and performance specification** (ECSS-E-ST-60-20C Rev. 2)
- 12:00 – 14:00: **Lunch BREAK**
- 14:00 – 14:30: **Gyro terminology and performance specification** (ECSS-E-ST-60-21C)
- 14:30 – 15:00: **Satellite AOCS Requirements** (ECSS-E-HB-60-30A)
- 15:00 – 15:30: **Final Discussion, Q&A**

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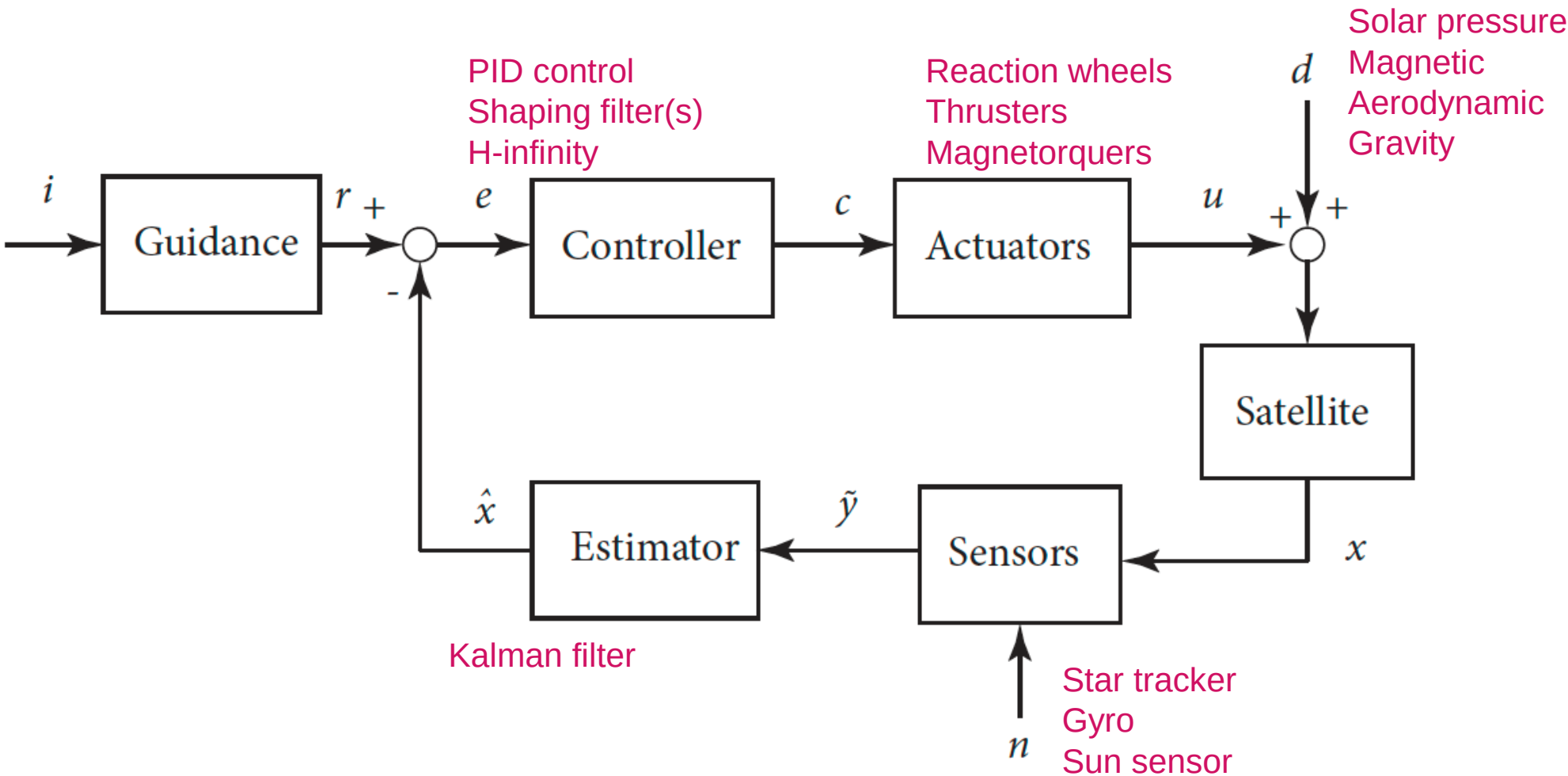
Overview

ECSS-E60 overview

- E60 branch was conceived as engineering standards and handbooks for **all systems involving control**
  (i.e. "feedback control" including e.g. thermal control, but not "ground control")
  - a **satellite** (e.g. w.r.t. its attitude and orbit control, or w.r.t. active thermal control) or a cluster of satellites;
  - a space **vehicle during RVD or EDLS**
  - a **launcher rocket**;
  - a **pointing system**; a **robot arm system, a rover**;
  - an automated **payload or laboratory facility**;
  - **any other technical system** involving control.
- Consequently, high level documents are quite generic
  - Control engineering Handbook, Control performance Standard
- Lower level documents are specific to AOCS or to Pointing Engineering
  - AOCS Requirements, Star Sensor, Gyros
  - ESA Pointing Error Engineering Handbook,

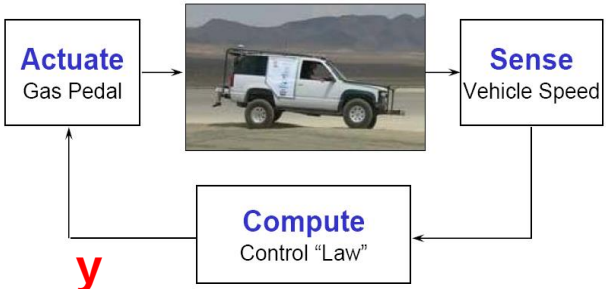
Typical spacecraft attitude control system

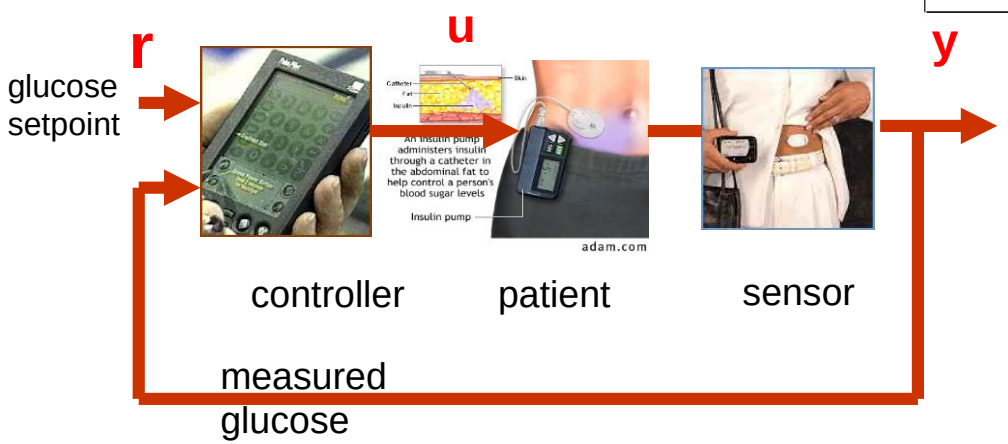


Examples of non space control systems

- Heating system
  - Plant: room
    Output controlled : temperature
    Controller: heating system e.g. thermostat
- Car cruise control
  - Plant: car
    Output controlled : velocity
    Controller: driver or automatic cruise control system
- Glucose control

(Honeywell, 1953)





ECSS-E60 history

WG	Document	comments
ECSS WG 1 (2001-2004)	Control Engineering (Sept 2004)	• Level 2 document originally published as a standard • Introduces the control terminology • ECSS Task Force 2 did not recognize it as a standard (addressing engineering process rather than requirements) • Its normative DRD's will be covered by the Satellite AOCS requirements Standard
No WG	Control Engineering Handbook (Dec 2010)	• Adapted from the level 2 original standard by the E60 Discipline Convenor
ECSS WG 2 (2005-2007)	Star Sensors Terminology and Performance Specification Standard (Nov 2008)	• Objective was to harmonise STR terminology and performance metrics • It suffered from the slow progress of // Control Performance WG
ECSS WG 3 (2005-2008)	Control Performance Standard (Nov 2008)	• Original draft was much bigger. WG was requested to derive a short standard addressing stability (intrinsic) and performance error (extrinsic)
No WG	Control Performance Guidelines (Dec 2010)	• Adapted from the original draft above by the WG3 convenor, as a Handbook (210 pages) for control engineers (no public review)
ESA TEC-EC and NPI (2008-2011)	ESA Pointing Error Engineering Handbook (July 2011)	• Objective was to specifically address Satellite Pointing Errors and clearly guide the error budget engineering process
ECSS WG 4 (2007-2011)	Satellite AOCS requirements Standard (August 2013)	• Standard set of AOCS requirements for satellites: - input for ESA MRD/SRD - normative requirements and documentation related to AOCS design and verification all along the satellite development
ECSS WG 5 (2012-2017)	Gyro Terminology and Performance Specification Standard (February 2017)	• Started 4Q2012 • Public Review 2015 • Published February 2017

The ECSS E60 branch

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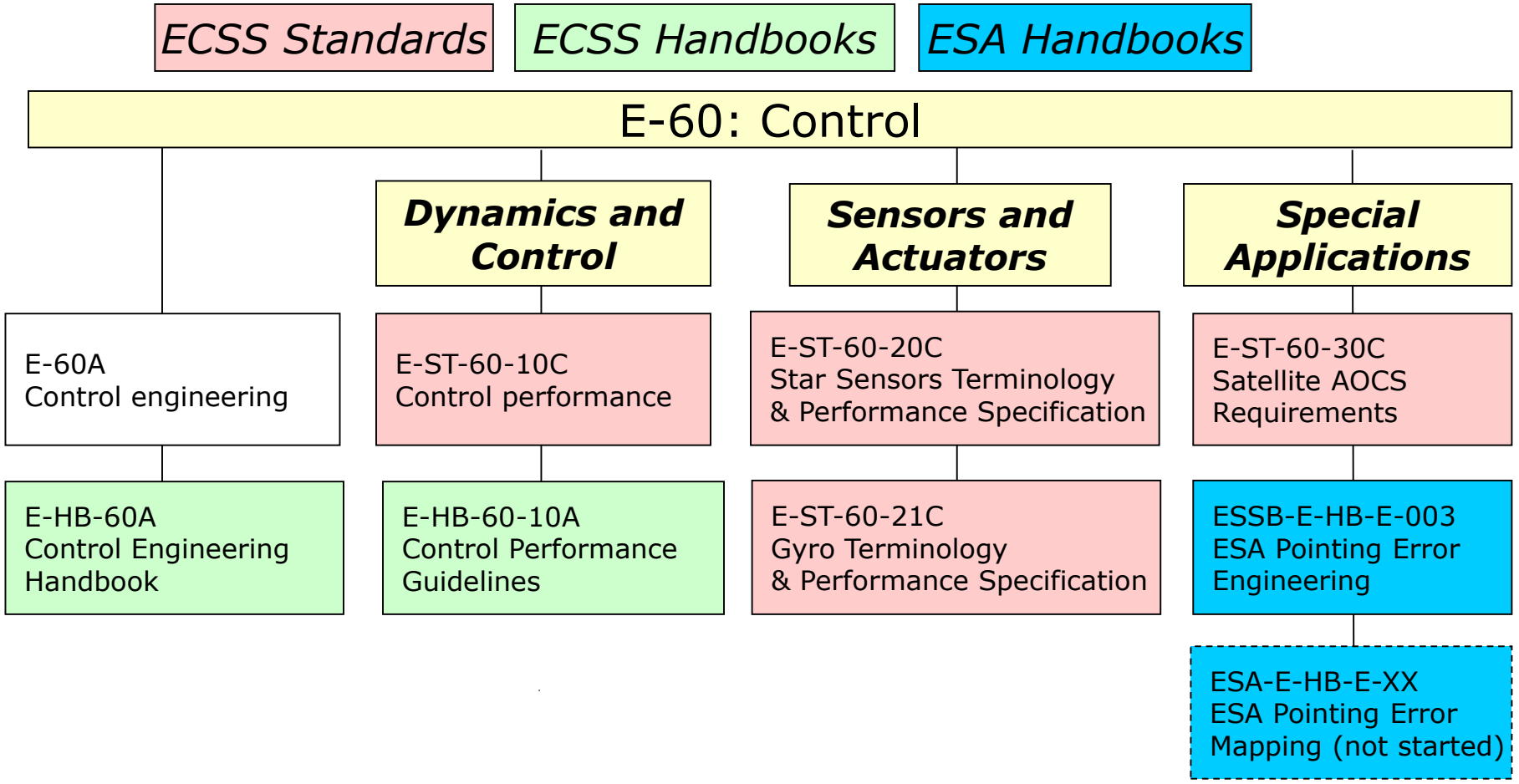

Contact points

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