Control Education and Careers

Abhishek Halder

Dept. of Applied Mathematics
University of California, Santa Cruz

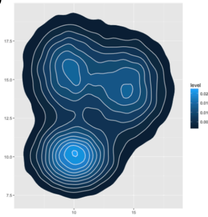
ahalder@ucsc.edu

Recap: filtering

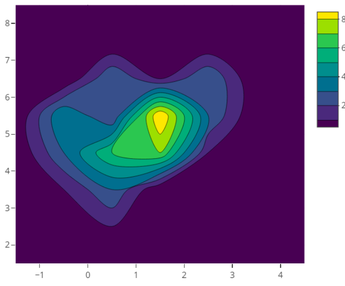
Filter = algorithm that solves the estimation problem

Two step algorithm

Step 1: prediction: compute the **prior** probability distribution over process state variables



Step 2: correction: compute the **posterior** probability distribution over process state variables



Recap: application to tracking space debris

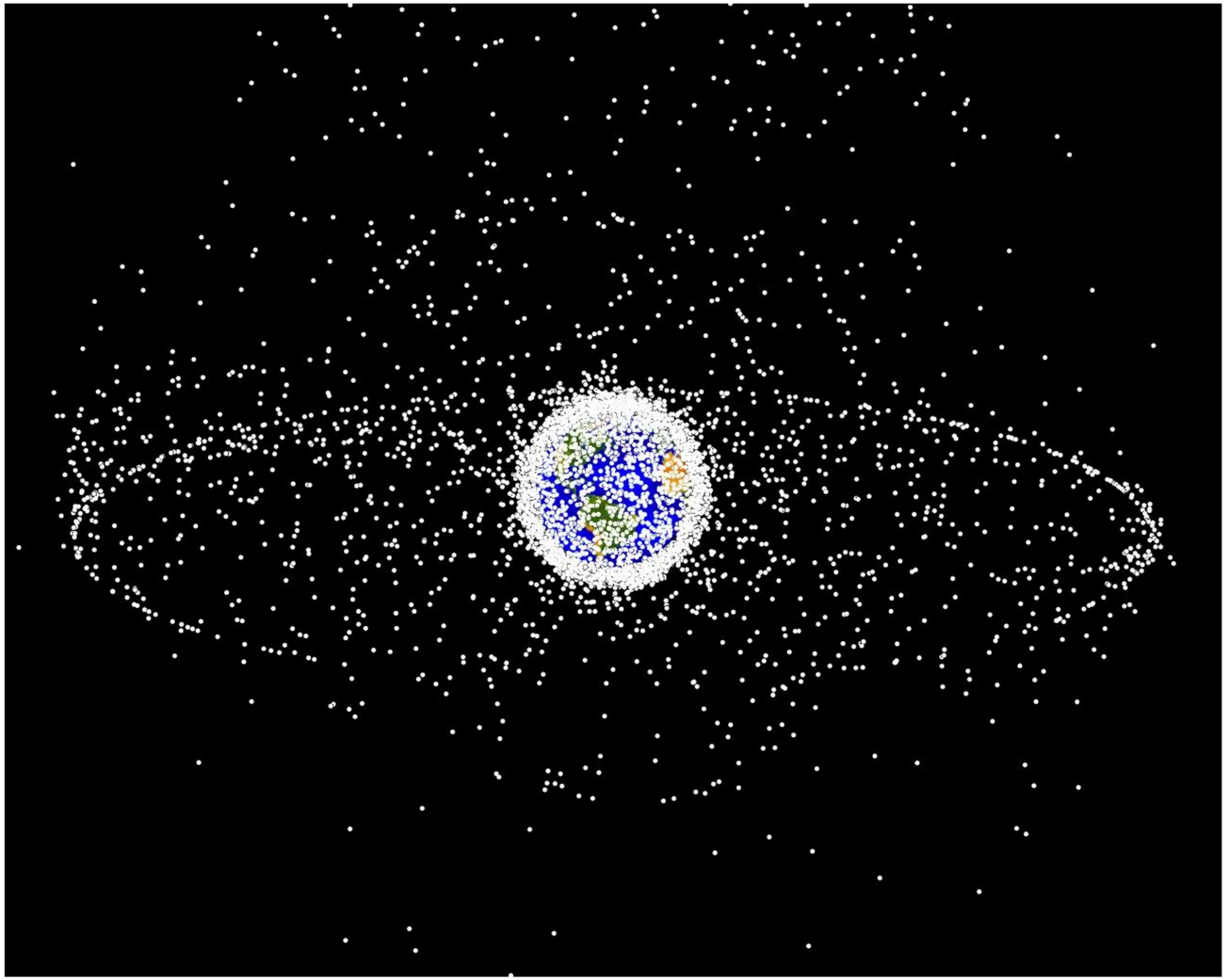


Image credit: NASA

Animation by the European SpaceAgency:

https://www.esa.int/ESA_Multimedia/Videos/2019/02/Distribution_of_space_debris_in_orbit_around_Earth

Plan for the rest of this course

Today: an overview of control education and careers

Tomorrow: review of the entire course: topics and concepts learnt

Friday: Q&A session

What are the control courses and when?

In US engineering **undergrad** program, several control and robotics courses

Typically, one **undergrad control** course in

— Electrical and Computer/Mechanical/Aerospace Engineering

Typically, one **undergrad robotics** course in

— Electrical and Computer/Mechanical/Aerospace Engineering

Other opportunities: senior design projects, internships, grad courses

What are the control courses and when?

Common prerequisites for **undergrad control** course:

— Multivariate Calculus
— Linear Algebra
— Ordinary Differential Equations
— Signals and Systems

These courses are usually **required** by most engineering programs at the freshman and sophomore levels

Common prerequisites for **undergrad robotics** course:

— Some or all of the above
— Statics/dynamics course
— Programming and data structures course

What are the control courses and when?

Usual topics covered in an **undergrad control** course:

— System modeling in continuous and discrete time
— Block diagrams
— Root locus and frequency domain design and analysis
— Some state space, if time permits
— Some laboratory experiments

Usual topics for **undergrad robotics** course:

— Dynamics of robots, motion planning
— Interconnecting different components
— Servos, sensors and actuators
— Hands on experience with hardware and software
— Computer vision, if time permits

What are the control courses and when?

In US engineering **grad** program, several control and robotics courses

Typically, multiple **grad control** courses in

— Electrical and Computer/Mechanical/Aerospace Engineering/Mathematics

Typically, one or more **grad robotics** courses in

— Electrical and Computer/Mechanical/Aerospace Engineering/Computer Science

Other opportunities: MS thesis, PhD dissertation, internships

What are the control courses and when?

Common prerequisites for **grad control** courses:

— Undergrad control course and/or
— Multivariable Calculus
— Linear Algebra
— Ordinary Differential Equations
— Signals and Systems
— Probability/statistics

Common prerequisites for **grad robotics** courses:

— Some or all of the above and/or
— undergrad robotics course or its prerequisites

What are the control courses and when?

Usual **grad control** courses:

— Optimization
— Optimal Control
— Linear Systems/Linear Control
— Nonlinear Control
— Stochastic Control
— Robust Control
— Adaptive Control
— Game theory

Usual **grad robotics** courses:

— Introductory robotics
— Robot Motion Planning
— Computer Vision
— Machine Learning

Careers

Three broad directions: industry, national labs, academia

Industry:

— Automotive
— Transportation networks
— Software design
— Robotics research labs
— Learning and optimization research labs
— Power engineering
— Aerospace engineering
— Chemical engineering
— Oil and gas
— Others

Careers

Three broad directions: industry, national labs, academia

National labs:

— NASA
— Computational engineering (Sandia, LLNL, LANL, ANL, PNNL)

Academia:

— PhD
— Postdoctoral researcher
— Faculty