Administração

54694-04 - Robótica Móvel Inteligente - Turma 1 - 2017/2 - Prof. ALEXANDRE DE MORAIS AMORY

Geral

Disciplina: Robótica Móvel Inteligente

Curso: PPGCC

Horário: 3ABCD;

Professor:

Alexandre M. Amory (alexandre.amory@pucrs.br)

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- Avisos
- Programa da Disciplina
- Alocação dos Laboratórios
- Cronograma
- Fórum de Discussão dos Alunos
- Nota sobre Plágio
- G = SE*0.3 + TF*0.7
- SE = 0.3*Apresentação + 0.3*Material didático + 0.4 Prova
- TF = 0.2* Proposta + 0.2*Andamento + 0.3*Demo + 0.3*Artigo
- EBooks
- PPTs
- History of Robotics
- Original ROS Course
- ROS Cheat Sheet
- ROS Cheat Sheet (ROS Indigo)
- ROS Books
- Recursos de Hardware do LSA

Learning Outcomes:

- the basics of how to model movement of simple mobile robots
- open source tools, libraries and software for programming mobile robots
- familiarity with the most relevant problems (and their solutions) in mobile robotics
- basic notion of the state of the art in software for mobile robotics
- hands-on experience programming robotics platforms and simulators

Not Seen in this Course:

- how to control manipulators
- teleoperated robots
- control theory
- underwater and flying physical robots. Perhaps simulated robots.

 Writing Tutorials

- http://wiki.ros.org/WritingTutorials

- http://docs.readthedocs.io/en/latest/getting_started.html

- https://help.github.com/articles/getting-started-with-writing-and-formatting-on-github/

 Using git

Tópico 1

Robot Modeling:

- Robot modeling with URDF and XACRO
- Use of Gazebo simulator
- Stage simulator

References

- Programming Robots with ROS - Morgan Quigley, Brian Gerkey, and William D. Smart
  - Chap 16 - Your Own Mobile Robot
- Robot Operating System (ROS): The Complete Reference
  - Simulation of Closed Kinematic Chains in Realistic Environments Using Gazebo
- ROS Robotics by Example - Carol Fairchild
  - Chap 2 - Creating Your First Two-Wheeled ROS Robot (in Simulation)
- ROS by Example. Vol 2 - Patrick Goebel
  - Chap 4. Creating a URDF Model for your Robot
- Effective Robotics Programming with ROS
  - Chap 4. 3D Modeling and Simulation
- How to use Player/Stage
  - http://playerstage-manual.readthedocs.io/en/latest/

Online Classes (MOOCs):

- https://www.youtube.com/watch?v=8ckSl4MbZLg

Papers

- Staranowicz, Aaron, and Gian Luca Mariottini. "A survey and comparison of commercial and open-source robotic simulator software." International Conference on PErvasive Technologies Related to Assistive Environments. 2011.
- Vaughan, Richard. "Massively multi-robot simulation in stage." Swarm Intelligence 2.2-4 (2008): 189-208.

- Kramer, James, and Matthias Scheutz. "Development environments for autonomous mobile robots: A survey." Autonomous Robots 22.2 (2007): 101-132.
- Quigley, Morgan, et al. "ROS: an open-source Robot Operating System." ICRA workshop on open source software. Vol. 3. No. 3.2. 2009.

Handouts and Laboratory:

- robot_modeling.ppt
- ROS_Lectures 4

Homework:

- robot_modeling.txt

 Entrega da Atividade de Modelagem do Robô usando URDF

Math of Movement:

- Representation of position and orientation in 2D Cartesian space
- Linear and angular velocity
- Wheeled vehicles: differential drive
- Wheel odometry

References

- Peter Corke Chaps 2 to 4
- Siciliano Sec 2.2
- Kelly Chap 2
- LeValle http://planning.cs.uiuc.edu/node659.html
- A Tutorial and Elementary Trajectory Model for the Differential Steering System of Robot Wheel Actuators
- A Primer on Odometry and Motor Control
- Kinematics Equations for Differential Drive and Articulated Steering. Thomas Hellström - Department of Computing Science Umeå University. 2011
- Learning Robotics Using Python
  - Chap 3- Mathematical modeling of the robot

Online Classes (MOOCs):

- Diff Drive
  - Control of Mobile Robots- 2.2 Differential Drive Robots
  - https://www.youtube.com/watch?v=aE7RQNhwnPQ
- Odometry
  - Control of Mobile Robots- 2.3 Odometry
  - https://www.youtube.com/watch?v=XbXhA4k7Ur8
- Trigonometry
  - Basic trigonometry | Basic trigonometry | Trigonometry | Khan Academy
  - https://www.youtube.com/watch?v=Jsiy4TxgIME
  - https://www.youtube.com/playlist?list=PLD6DA74C1DBF770E7

Online Simulation:

- https://www.geogebra.org/m/FSHp7y9B
- https://www.geogebra.org/m/egXj3fNF#chapter/47345
- https://www.geogebra.org/m/nDnPzHWs#chapter/47323

Handouts and Laboratory:

- Movement
  - movement.ppt
  - ROS_Lectures 1 to 3

Homework:

- ROS tutorial.txt
- Movement.txt

Entrega da Atividade de Modelagem de Movimendo do Robô Diferencial

Navigation Stack:

- introduction to AMCL, move_base, gmapping using Turtlebot

References

- Programming Robots with ROS - Morgan Quigley, Brian Gerkey, and William D. Smart
  - Chap 17 - Configuring the Navigation Stack
- http://wiki.ros.org/turtlebot_navigation

Online Classes (MOOCs):

- https://www.youtube.com/playlist?list=PLD6DA74C1DBF770E7
- https://www.youtube.com/watch?v=Mv1mbsMfbmI - TurtleBot Localization Primer
- https://www.youtube.com/watch?v=3ydRXC76MV0 - TurtleBot Rviz Primer

Handouts and Laboratory:

- Turtlebot.pdf
- ROS_Lectures 5 to 7

Homework:

- http://moorerobots.com/blog/post/1 - Execute step by step until the end of Part 3.

Entrega da Atividade de Uso do Navigation Stack no Turtlebot

Entrega da Atividade de Seminário sobre Middlewares de Robótica

Fórum do Semário de Middleware

Seminário sobre Middleware

Tópico 2 não está disponível

Tópico 3

Introduction to Computer Vision for Robotics

- Introduction to digital images
- How does image work?
- Color spaces
- Python OpenCV

- **Bibliography**
  - Learning OpenCV Computer Vision in C++ with the OpenCV Library. Bradski, G. Kaehler, A. O'Reilly Media. - Chapters 1-5
  - Computer Vision: Algorithms and Applications. Richard Szeliski. Springer. - Chapters 1-2

Filtering and Edge Detectors

- Image filtering
- Image convolution
- Padding
- Edge detection

Feature Detection and Extraction

- Image pyramids
- Feature extraction
- Histogram of Oriented Gradients
- Interest Point Detection
- Corner Detector (Harris)
- Scale Invariant Detector (SIFT)
- Motion Estimation (Optical Flow)

- **Bibliography**
  - Computer Vision: Algorithms and Applications. Richard Szeliski. Springer. - Chapters 3-4
  - Fundamentals of Computer Vision. Shah, M. Computer Science Department. University of Central Florida. - Chapter 2-4

Additional Material

- **MOOC**
  - **PennX: ROBO2x Robotics: Vision Intelligence and Machine Learning**
- **Classes**
  - **CS6670 - Computer Vision**
  - **UCF Computer Vision Video Lectures 2014**
  - **Computer Vision (CS 543 / ECE 549) – Spring 2017**
  - **ECSE-4540: Intro to Digital Image Processing**

 Entrega da Atividade de Tracking usando o Turtlebot

 Entrega de Atividade de Detecção de Bordas usando Turtlebot

Introduction to Machine Learning

- Introduction to machine learning
- Supervised learning
- Semi-Supervised learning
- Unsupervised learning
- Reinforcement learning

Supervised Learning

- Basic concepts
- Linear regression
- Cost function
- Gradient descent
- Feature scaling
- Classification
- Logistic regression
- Multiclass classification

Artificial Neural Networks

- Basic concepts
- Polynomial Regression
- Non-linear classification
- Neural Network
- Logic gates
- Cost function
- Backpropagation

Deep Learning

- Convolutional Neural Networks (CNN)
- Basic concepts
- Convolutional layers
- Activation functions
- Pooling layers
- Fully-connected layers
- Softmax classifier
- Other details
- Recurrent Neural Networks (RNN)
- Long Short Term Memory networks (LSTM)

Additional Material

- **Bibliography**
  - Introduction to Machine Learning. Alpaydin E. The MIT Press, second edition, 2009, 584 p.
  - Neural Networks and Deep Learning. Michael A. Nielsen, Determination Press, 2015.
  - Deep Learning. Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.
  - Machine Learning. Mitchell, T.M. McGraw-Hill Science, 1997, 432 p.
  - Introduction to Machine Learning. Smola, A. Vishwanathan, S.V.N. Cambridge University Press, 2008, 234 p.
- **MOOC**
  - PennX: ROBO2x Robotics: Vision Intelligence and Machine Learning
  - Coursera: Practical Machine Learning
  - Coursera: Stanford Machine Learning
  - CS231n: Convolutional Neural Networks for Visual Recognition

Final Project

Important Dates:

- deadline for proposal and current status: November, 7 th
- demonstration day: December 5th and 12th
- deadline for the paper: December 12th

Groups, Subjects, Presentation Dates:

Group member	Subject	Demo Date
Desiree	Intelligent Turtlebot Gripper	
Ezequiel	Ontology and Robotics ????	
Martin & Paulo & Luisa	Obstacle detection and avoidance for autonomous boat	
Davi & Marcelo	ROS integration with GAMS/MADARA for autonomous boat	
Vinicius	Multi Agents in a Disaster Scenario	
Debora & Tabajara & Tulio	Jason Gazebo Interface	
Daniele	AgentSpeak-Py and ROS integration	
Vagner	PUCRS Campus in Gazebo	

Project Specification and Current Status

Final Project

 Paper - Final Project

Administração

Other Relevant Topics

 Control Theory for Computer Scientists

- Philipp K. Janert. Feedback Control for Computer Systems
- Karl Johan Aström, Richard M. Murray. Feedback Systems: An Introduction for Scientists and Engineers
- Control Systems Lectures
  - https://www.youtube.com/watch?v=O-OqgFE9SD4&list=PLUMWjy5jgHK3j74Z5Tq6Tso1fSfVWZC8L
- http://www.inpharmix.com/jps/PID_Controller_For_Lego_Mindstorms_Robots.html
- http://hackaday.com/2015/12/24/beyond-control-maths-of-a-control-system/

Seminar não está disponível