

# Modern Robotics Videos

From Mech  
Jump to navigationJump to search

These videos accompany the textbook *Modern Robotics* ([http://hades.mech.northwestern.edu/index.php/Modern\\_Robotics](http://hades.mech.northwestern.edu/index.php/Modern_Robotics)).

**Click here** (<http://modernrobotics.northwestern.edu>) to watch the video lectures embedded in a convenient viewing environment.

**YouTube playlist for all *Modern Robotics* videos.** (<https://www.youtube.com/playlist?list=PLggLP4f-rq02vX0OQQ5vrCxbJrzamYDfx>)

Video supplements for *Modern Robotics* are linked below. They cover much of the material in the book, but at a fast pace. To fully understand the material, you will need to consult the book and work some exercises! A good strategy for self-study may be to watch the video first, to get a quick introduction to the material, then read the corresponding section in the book.

Contents

- 1 Introduction
- 2 Chapter 2: Configuration Space
- 3 Chapter 3: Rigid-Body Motions
- 4 Chapter 4: Forward Kinematics
- 5 Chapter 5: Velocity Kinematics and Statics
- 6 Chapter 6: Inverse Kinematics
- 7 Chapter 7: Kinematics of Closed Chains
- 8 Chapter 8: Dynamics of Open Chains
- 9 Chapter 9: Trajectory Generation
- 10 Chapter 10: Motion Planning
- 11 Chapter 11: Robot Control
- 12 Chapter 12: Grasping and Manipulation
- 13 Chapter 13: Wheeled Mobile Robots
- 14 Capstone Project, Mobile Manipulation

## Introduction

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq02hvwNGpSWJMqjZhLpuDM-Y>) (Total running time: 2:16)

1. **Introduction to the Lightboard** (<https://youtu.be/jVu-Hijns70>) (1:33)

2. **Acknowledgments** (<https://youtu.be/9usycd3tnCk>) (0:43)

## Chapter 2: Configuration Space

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq01z8VLqhDC94W2nWpWpZoMj>) (Total running time: 27:35)

1. **Chapters 2 and 3: Foundations of Robot Motion** (<https://youtu.be/csYtU2GY7FY>) (2:12)

2. **Chapter 2.1: Degrees of Freedom of a Rigid Body** (<https://youtu.be/z29hYlagOYM>) (5:15)

3. **Chapter 2.2: Degrees of Freedom of a Robot** (<https://youtu.be/zI64DyaRUvQ>) (5:43)

4. **Chapter 2.3.1: Configuration Space Topology** (<https://youtu.be/FyLNR3edOds>) (4:37)

5. **Chapter 2.3.2: Configuration Space Representation** (<https://youtu.be/PPgJPjCUIXU>) (3:52)

6. **Chapter 2.4: Configuration and Velocity Constraints** (<https://youtu.be/A14ArEZ47LE>) (4:21)

7. **Chapter 2.5: Task Space and Workspace** (<https://youtu.be/hTuW51CpUg4>) (1:35)

## Chapter 3: Rigid-Body Motions

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq01NLHOh2vVPPJZ0rxkbVFNc>) (Total running time: 40:35)

1. **Chapter 3: Introduction to Rigid-Body Motions** (<https://youtu.be/29LhXWjn7Pc>) (2:10)

2. **Chapter 3.2.1: Rotation Matrices (Part 1 of 2)** ([https://youtu.be/OZucG1DY\\_sY](https://youtu.be/OZucG1DY_sY)) (2:54)

3. **Chapter 3.2.1: Rotation Matrices (Part 2 of 2)** (<https://youtu.be/6KIPusOv5fA>) (4:14)

4. **Chapter 3.2.2: Angular Velocities** (<https://youtu.be/zJJldJYMxVU>) (3:28)

5. **Chapter 3.2.3: Exponential Coordinates of Rotation (Part 1 of 2)** ([https://youtu.be/v\\_KBHaG0mas](https://youtu.be/v_KBHaG0mas)) (2:04)

6. **Chapter 3.2.3: Exponential Coordinates of Rotation (Part 2 of 2)** (<https://youtu.be/WHn9xJl43nY>) (3:43)

7. **Chapter 3.3.1: Homogeneous Transformation Matrices** (<https://youtu.be/vlb3P7arbkU>) (6:22)

8. **Chapter 3.3.2: Twists (Part 1 of 2)** ([https://youtu.be/mvGZtO\\_ruj0](https://youtu.be/mvGZtO_ruj0)) (5:00)

9. **Chapter 3.3.2: Twists (Part 2 of 2)** (<https://youtu.be/VTv0qmLNvjg>) (2:39)

10. **Chapter 3.3.3: Exponential Coordinates of Rigid-Body Motion** (<https://youtu.be/1jYMvm1U2D0>) (5:00)

11. **Chapter 3.4: Wrenches** (<https://youtu.be/0wsYPJPGtKE>) (3:01)

## Chapter 4: Forward Kinematics

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq00efLcgMcG1m4k5CKIgRcGh>) (Total running time: 13:40)

1. **Chapter 4.1.1: Product of Exponentials Formula in the Space Frame** ([https://youtu.be/hE\\_Duih\\_7JE](https://youtu.be/hE_Duih_7JE)) (6:31)

2. **Chapter 4.1.2: Product of Exponentials Formula in the End-Effector Frame** (<https://youtu.be/27jUrkFdyks>) (4:41)

3. **Chapter 4: Forward Kinematics Example** (<https://youtu.be/cKHsil0V6Qk>) (3:28)

## Chapter 5: Velocity Kinematics and Statics

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq00oA7lrv6dS5C15RYjqj4Zi>) (Total running time: 34:33)

1. **Chapter 5: Velocity Kinematics and Statics** (<https://youtu.be/6tj8QLF69Ok>) (8:28)

2. **Chapter 5.1.1: Space Jacobian** (<https://youtu.be/KbI8HN3imtQ>) (5:59)

3. **Chapter 5.1.2: Body Jacobian** (<https://youtu.be/69HeL2XvL9Y>) (4:51)

4. **Chapter 5.2: Statics of Open Chains** (<https://youtu.be/eBti6XIoR5U>) (2:54)

5. **Chapter 5.3: Singularities** (<https://youtu.be/vjJgTvnQpBs>) (6:37)

6. **Chapter 5.4: Manipulability** ([https://youtu.be/8VSrYDi\\_cs0](https://youtu.be/8VSrYDi_cs0)) (5:44)

## Chapter 6: Inverse Kinematics

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq01fi62ek1BoV1yiPHLL3Vt->) (Total running time: 13:54)

1. **Chapter 6: Inverse Kinematics of Open Chains** (<https://youtu.be/nin2TbMuhR0>) (4:03)

2. **Chapter 6.2: Numerical Inverse Kinematics (Part 1 of 2)** (<https://youtu.be/VhUA0jf7ti8>) (5:04)

3. **Chapter 6.2: Numerical Inverse Kinematics (Part 2 of 2)** (<https://youtu.be/24cXvgQl-nk>) (4:47)

## Chapter 7: Kinematics of Closed Chains

YouTube playlist ([https://www.youtube.com/playlist?list=PLggLP4f-rq006EwbPbqZE\\_UcxAUGghSfA](https://www.youtube.com/playlist?list=PLggLP4f-rq006EwbPbqZE_UcxAUGghSfA)) (Total running time: 8:34)

1. **Chapter 7: Kinematics of Closed Chains** (<https://youtu.be/5wCK6XGC3ig>) (8:34)

## Chapter 8: Dynamics of Open Chains

YouTube playlist ([https://www.youtube.com/playlist?list=PLggLP4f-rq00TQamz2pXjzPWpuxhVN\\_Vy](https://www.youtube.com/playlist?list=PLggLP4f-rq00TQamz2pXjzPWpuxhVN_Vy)) (Total running time: 50:19)

1. **Chapter 8.1: Lagrangian Formulation of Dynamics (Part 1 of 2)** ([https://youtu.be/1U6y\\_68CjeY](https://youtu.be/1U6y_68CjeY)) (6:41)

2. **Chapter 8.1: Lagrangian Formulation of Dynamics (Part 2 of 2)** (<https://youtu.be/BjD-pL819LA>) (5:35)

3. **Chapter 8.1.3: Understanding the Mass Matrix** (<https://youtu.be/7PFQou5l9do>) (5:21)

4. **Chapter 8.2: Dynamics of a Single Rigid Body (Part 1 of 2)** (<https://youtu.be/9pdqePt1Nbg>) (6:13)
5. **Chapter 8.2: Dynamics of a Single Rigid Body (Part 2 of 2)** (<https://youtu.be/2rUWVdslaI4>) (4:05)
6. **Chapter 8.3: Newton-Euler Inverse Dynamics** (<https://youtu.be/ZASVKAlegfQ>) (5:53)
7. **Chapter 8.5: Forward Dynamics of Open Chains** (<https://youtu.be/L8zpJOxDbh4>) (3:43)
8. **Chapter 8.6: Dynamics in the Task Space** (<https://youtu.be/iQa01aFgf8U>) (1:32)
9. **Chapter 8.7: Constrained Dynamics** (<https://youtu.be/E6Yp6DwJh24>) (5:10)
10. **Chapter 8.9: Actuation, Gearing, and Friction** (<https://youtu.be/w1kYLT3pETc>) (6:06)

## Chapter 9: Trajectory Generation

YouTube playlist ([https://www.youtube.com/playlist?list=PLggLP4f-rq00wo1z\\_Or2rRPA1pStwmlY](https://www.youtube.com/playlist?list=PLggLP4f-rq00wo1z_Or2rRPA1pStwmlY)) (Total running time: 28:45)

1. **Chapters 9.1 and 9.2: Point-to-Point Trajectories (Part 1 of 2)** (<https://youtu.be/1JRMqfEm79c>) (5:40)
2. **Chapters 9.1 and 9.2: Point-to-Point Trajectories (Part 2 of 2)** ([https://youtu.be/0ZqeBEa\\_MWo](https://youtu.be/0ZqeBEa_MWo)) (3:07)
3. **Chapter 9.3: Polynomial Via Point Trajectories** (<https://youtu.be/sWPPq9-5YOc>) (2:59)
4. **Chapter 9.4: Time-Optimal Time Scaling (Part 1 of 3)** ([https://youtu.be/DRFA\\_iwH\\_HQ](https://youtu.be/DRFA_iwH_HQ)) (5:38)
5. **Chapter 9.4: Time-Optimal Time Scaling (Part 2 of 3)** (<https://youtu.be/WR2oPxJi-H0>) (6:36)
6. **Chapter 9.4: Time-Optimal Time Scaling (Part 3 of 3)** (<https://youtu.be/VqfUuh3BgeU>) (4:45)

## Chapter 10: Motion Planning

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq01Q3cIJrnWFPRTpUwSlr4mG>) (Total running time: 49:36)

1. **Chapter 10.1: Overview of Motion Planning** (<https://youtu.be/aC4LQuB4Cic>) (4:33)
2. **Chapter 10.2.1: C-Space Obstacles** (<https://youtu.be/s2qrMwqm4D0>) (4:43)
3. **Chapter 10.2.3: Graphs and Trees** (<https://youtu.be/QpOuyqd6nnc>) (2:23)
4. **Chapter 10.2.4: Graph Search** (<https://youtu.be/ZI800-2jv38>) (9:25)
5. **Chapter 10.3: Complete Path Planners** (<https://youtu.be/SlHzl0jsLK0>) (3:04)
6. **Chapter 10.4: Grid Methods for Motion Planning** (<https://youtu.be/kCZAgL3jdxk>) (4:25)
7. **Chapter 10.5: Sampling Methods for Motion Planning (Part 1 of 2)** (<https://youtu.be/rKe6HO8LDu0>) (3:11)
8. **Chapter 10.5: Sampling Methods for Motion Planning (Part 2 of 2)** ([https://youtu.be/Ao7p\\_xiUu4s](https://youtu.be/Ao7p_xiUu4s)) (7:13)
9. **Chapter 10.6: Virtual Potential Fields** (<https://youtu.be/8Vva0bnMIEI>) (5:09)
10. **Chapter 10.7: Nonlinear Optimization** (<https://youtu.be/-z6Rlei8iPE>) (5:30)

## Chapter 11: Robot Control

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq02N54sD6xwdDWIDScvb32Pp>) (Total running time: 57:51)

1. **Chapter 11.1: Control System Overview** (<https://youtu.be/mGuDXIZEoSc>) (3:24)
2. **Chapter 11.2.1: Error Response** (<https://youtu.be/ddkUszFVTUk>) (2:49)
3. **Chapter 11.2.2: Linear Error Dynamics** (<https://youtu.be/1TY4tpSnjBg>) (4:20)
4. **Chapter 11.2.2.1: First-Order Error Dynamics** (<https://youtu.be/MfhHENvUnhg>) (1:56)
5. **Chapter 11.2.2.2: Second-Order Error Dynamics** (<https://youtu.be/4zOGHJWuxlg>) (5:37)
6. **Chapter 11.3: Motion Control with Velocity Inputs (Part 1 of 3)** (<https://youtu.be/QFCbTVJqm8I>) (4:13)
7. **Chapter 11.3: Motion Control with Velocity Inputs (Part 2 of 3)** (<https://youtu.be/NAXmXg1gCI0>) (6:02)
8. **Chapter 11.3: Motion Control with Velocity Inputs (Part 3 of 3)** (<https://youtu.be/WuhEEidkes8>) (4:29)
9. **Chapter 11.4: Motion Control with Torque or Force Inputs (Part 1 of 3)** (<https://youtu.be/HAVBtupm8zM>) (4:05)
10. **Chapter 11.4: Motion Control with Torque or Force Inputs (Part 2 of 3)** (<https://youtu.be/992hdsGgVIE>) (5:33)
11. **Chapter 11.4: Motion Control with Torque or Force Inputs (Part 3 of 3)** (<https://youtu.be/MV-xBPP3H2k>) (7:12)
12. **Chapter 11.5: Force Control** (<https://youtu.be/M1U629sREiY>) (2:45)
13. **Chapter 11.6: Hybrid Motion-Force Control** (<https://youtu.be/UR0GpaaBVKk>) (5:26)

## Chapter 12: Grasping and Manipulation

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq03J3TLUyIW0ZGfejrTjHayw>) (Total running time: 58:24)

1. **Chapter 12: Grasping and Manipulation** (<https://youtu.be/jAhpRoIF-zg>) (4:55)
2. **Chapter 12.1.1: First-Order Analysis of a Single Contact** (<https://youtu.be/EfBwUbCP5nk>) (4:14)
3. **Chapter 12.1.2: Contact Types: Rolling, Sliding, and Breaking** (<https://youtu.be/k26cAEmTSNQ>) (5:41)
4. **Chapter 12.1.3: Multiple Contacts** (<https://youtu.be/aZaAOvmzkmw>) (4:48)
5. **Chapter 12.1.6: Planar Graphical Methods (Part 1 of 2)** (<https://youtu.be/Pfi5yRsyt8>) (4:19)
6. **Chapter 12.1.6: Planar Graphical Methods (Part 2 of 2)** (<https://youtu.be/ly66qBXt-Yc>) (4:44)
7. **Chapter 12.1.7: Form Closure** (<https://youtu.be/GjAtNb3VDZQ>) (4:07)
8. **Chapter 12.2.1: Friction** (<https://youtu.be/FY92f7gssWc>) (5:38)
9. **Chapter 12.2.2: Planar Graphical Methods** (<https://youtu.be/Qa74jWgtlnQ>) (4:02)
10. **Chapter 12.2.3: Force Closure** (<https://youtu.be/6RWFFMtD5k8>) (4:04)
11. **Chapter 12.2.4: Duality of Force and Motion Freedoms** (<https://youtu.be/PPI0yuFJCVM>) (3:32)
12. **Chapter 12.3: Manipulation and the Meter-Stick Trick** ([https://youtu.be/luyzvBT\\_Ykc](https://youtu.be/luyzvBT_Ykc)) (5:16)
13. **Chapter 12.3: Transport of an Assembly** (<https://youtu.be/Ad5dbYVuaPM>) (3:04)

## Chapter 13: Wheeled Mobile Robots

YouTube playlist (<https://www.youtube.com/playlist?list=PLggLP4f-rq00uzTEwsywVcTF2fJ2YqAXX>) (Total running time: 59:26)

1. **Chapter 13.1: Wheeled Mobile Robots** ([https://youtu.be/NYO2X3eJ\\_Ro](https://youtu.be/NYO2X3eJ_Ro)) (2:10)
2. **Chapter 13.2: Omnidirectional Wheeled Mobile Robots (Part 1 of 2)** (<https://youtu.be/NcOT9hOsceE>) (6:02)
3. **Chapter 13.2: Omnidirectional Wheeled Mobile Robots (Part 2 of 2)** (<https://youtu.be/B1K-ti5Lqjc>) (3:00)
4. **Chapter 13.3.1: Modeling of Nonholonomic Wheeled Mobile Robots** (<https://youtu.be/fPHVhlRFFCk>) (5:00)
5. **Chapter 13.3.2: Controllability of Wheeled Mobile Robots (Part 1 of 4)** (<https://youtu.be/hTEZ98hozSM>) (4:07)
6. **Chapter 13.3.2: Controllability of Wheeled Mobile Robots (Part 2 of 4)** (<https://youtu.be/S7Y2aUQiDCw>) (6:28)
7. **Chapter 13.3.2: Controllability of Wheeled Mobile Robots (Part 3 of 4)** (<https://youtu.be/e5uCP8vWV8E>) (5:38)
8. **Chapter 13.3.2: Controllability of Wheeled Mobile Robots (Part 4 of 4)** (<https://youtu.be/rm24IyHpCAs>) (5:26)
9. **Chapter 13.3.3: Motion Planning for Nonholonomic Mobile Robots** (<https://youtu.be/jOesC0wKpTQ>) (5:02)
10. **Chapter 13.3.4: Feedback Control for Nonholonomic Mobile Robots** (<https://youtu.be/STF1Ubf3moU>) (5:42)
11. **Chapter 13.4: Odometry** (<https://youtu.be/eQ9E0Zvp9jw>) (4:32)
12. **Chapter 13.5: Mobile Manipulation** (<https://youtu.be/1MgqpD7v2x0>) (6:19)

## Capstone Project, Mobile Manipulation

**Capstone Project, Mobile Manipulation** (<https://youtu.be/Q1CekpBW6Js>) (2:27)

Retrieved from "https://hades.mech.northwestern.edu//index.php?title=Modern\_Robotics\_Videos&oldid=26280"

- This page was last edited on 3 June 2022, at 12:18.
- This page has been accessed 672,920 times.