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Coursera robotics mobility quiz answers

How can we create agile microair vehicles that can run autonomously in messy indoor and outdoor environments? You will get an introduction to the mechanics of flight and the design of quadrotor flying robots and will be able to develop dynamic models, infer controllers, and synthesize planners for operation in three dimensional environments. You will be exposed to the challenges of using noisy sensors for localization and manoeuvring in complex, three-dimensional environments. Finally, you'll gain insight by seeing real-world examples of the possible applications and challenges for the rapidly growing drone industry. Mathematical prerequisites: Students who take this course are expected to have some familiarity with linear algebra, single variable calculus, and differential equations. Programming prerequisites: Some experience programming with MATLAB or Octave is recommended (we will use MATLAB in this course.) MATLAB requires the use of a 64-bit computer. Contains Tasks, files and codes for MOOC on Robotics: Mobility on Coursera taught by Prof. Vijay Kumar. Part of Robotics Specialization. Maximum parts performed on Octave. If you are enrolled in the course, do not copy. Page 2 contains tasks, files and codes for MOOC on robotics: Mobility at Coursera taught by Prof. Vijay Kumar. Part of Robotics Specialization. Maximum parts performed on Octave. If you are enrolled in the course, do not copy. The course has a lot of interesting material, but I think that a few points can be improved:1) Exercises with Matlab are not programming them (apart from the PD controller). In my opinion, more detailed exercises (with a guide to solving them) would help to understand better the concepts behind the theory. For example, programming a rimless wheel or a SLIP template.2) The course has a strong weight in theory. Some of the lectures were boring a difficult one to follow. As I said before, a more practical approach would be more rewarding. 3) Quizzes were sometimes based on intuition, or topics outside the course, rather than subjects learned from the lessons learned. On the other hand, the authorities were heavily involved in the course. In addition, a comprehensive list of additional resources (books, papers) is a plus. I think the following meetings will be better than the first! 首先这个系列的第个单元是空中机器人.博客如下: 1 Robotics: Aerial Robotics 第1+2周 课程学习记录及课后习题解答 1 Robotics: Robotics 第3+4周 课程学习记录及课后习题解答 2 Robotics: Computational Motion Planning 第1周(内含Dijkstra 啦 A* MATLAB代码手把手教学)课后习题解答 <2> 2 Robotics: The motion planning of the computational movement 第 2+3+4周 课后习题解答 此课程在Coursera需要科学上网才能观看.但是b站有人搬运.只是无中英字幕.放下B站啦Coursera的课程链接 WEEK 1 1.In Newton's F = m a F=ma F=ma what does F F F F? Force 2.Why is bioinspiration promoted over biomimicry All of the above 3.If an animal or a robot wants to turn left, should it swing its tail Left 4.Which is an example of intelligence baked into the body? Kangaroo tendons act as springs 1.1.2 1.1.2 1.The speed of aircraft is often described in units of Mach (sound speed at standard sea level conditions). What is the speed of Helios 2 in Mach? 207 2.Acceleration is sometimes measured in g (acceleration due to gravity on the Earth's surface). What is cheetah acceleration in units of g? 1.3 解释:记得看清这里的单位是.几个g的加速度 3.Turning left in the house with the red roof is an example of navigation using what part of the hippocampus? Place cells 4.Turning left after 25 meters is an example of navigation using what part of the hippocampus? Grid cells 1.1.3 Legged Mobility: Dynamic movement and management of energy 1.In the above image, we see three robots with leg forces on the ground drawn in blue. Match robots with their resulting jumps. Robot b will jump highest, robot a will jump furthest sideways. 2.Hamiltonian systems have their total energy (the sum of potential and kinetic energies) preserved. Which of these can best be modeled as a Hamiltonian system. A pendulum in a clock swinging back and forth 3.Assuming these two engines are about the same size, which one is likely to produce more torque and which one will have higher inertia? The engine on the right will produce more torque and have higher inertia 4.Which are examples of programming work? A robot that opens a door A robot that runs over uneven terrain WEEK 2 1.Energy-saving transport costs are a measure commonly used to evaluate the energetic efficiency of robotic movement, and it is given by the energy needed to travel a given distance with a robot, divided by the energy needed to lift the robot the same distance towards vertical gravity. Which of the trigonometric relationships below provide the energetic transport costs (COT) for the rimless wheel driven by gravity as a function of the ramp angle? Use the distance traveled in your calculations to represent the distance travelled. COT=Tan (rampAngle) 2.The Cornell Ranger has a mass of 9.91 kg and went a total distance of 65,243 m using 1,774,800 J battery energy. What are the transportation costs for the Cornell Ranger? Assume a gravitational acceleration of 9.81 m/s ^ 2 in the calculation of your answer. 0.28 解释:COT = E / mgd; E = System energy supply, m = mass, d = distance, g = standard heavy weight COT = 1774800/(9.919.8165243) = 0,28 3.What ramp angle is required to provide a transport cost of 0.2 for the rimless wheel, which is roughly equivalent to the efficiency of human walking? 11 degrees 解释:arctan(0.2)=11 4.Vi have seen that energy is often used very effectively for movement in biology compared to in robots. The cost of storing energy (in terms of weight) is another factor that comes into play in determining motion ability – the more weight is stored in fuel, the more mass actuators have to move! Let's compare how much it weighs to store a given energy in biological fuel – i.e. How many kg of battery weight would be required for a robot to go a marathon? Suppose that a marathon takes 5960 KJ to go (this is an extremely rough estimate assuming a 72 kg person go it with an energetic transport cost of 0.2) and that lithium polymer batteries have a mass of 0.002 kg per KJ of energy storage. Around to the nearest kilo. Just to put this in perspective, the same energy can be contained in less than 7 candy bars, which have a total weight of less than 0.4 kg! 12 解释:0.002*5960=11.96 四舍五入 12 2.1.2 Run like a spring-loaded pendulum 1.Given a robot with a leg length of 0.4 m, what is the estimated maximum possible walking speed in metres per second according to the Froude number? Suppose an acceleration due to gravity of 10m/s^2. 2 解释:F=v^2/(gl),v=sqrt(1100.4)=2 2.Assume that the energetic optimal transition speed for a robot output occurs at a Froude number of 0.5. What is the term for the optimal speed of the transition from walk to race in terms of leg length d? Assume a gravitational acceleration of 10m/s^2. Enter you correspond in simplest form, using sqrt () to represent any square roots. (For example, the square root of 2d is written as sqrt(2d)). sqrt(0.510d) 3.Which of the following energy areas best represents the energy under the position in the middle of a robot running with SLIP-like dynamics? The blue curve shows kinetic energy, and the red curve shows gravitational energy. Suppose the horizontal axis is time and the vertical axis is energy. 如此图 4.Here is actual data for the center-of-mass trajectory of a robot that runs primarily in directions marked y and z. From this data, which template best explains movement observed? LLS 2.1.3 Control of the spring-loaded inverted pendulum 1.Download the MATLAB file called Quiz_2_1_1_Raibert_Hopper. To run the simulation, Quiz_2_1_1_Question_1 without arguments. Your first task is to set the pressure duration using the slider so that the funnel reaches a stable mode jump height between 1m and 1.1 m (indicated by the horizontal green and red lines in the generated plot) at the end of the simulation. Give the resulting pressure duration in seconds that meet these goals as your answer. 0.00071429 2.Now we will tune the forward speed controller. To run the simulation, Quiz_2_1_1_Question_2 without arguments. Keep in mind that the neutral point is estimated at each step and that the forward speed controller consists of a proportional controller that puts the toe in front of or behind the neutral point to achieve the desired speed. What proportional gain from the forward speed regulator causes the robot to accelerate from rest to a speed between 0.9 m/s and 1.1 m/s without ever going over 1.1 m/s? 0.087439 3.Now we will tune the pitch controller to achieve a desired pitch of π 12 \frac{\pi}{12} 12π radians. To run the simulation, Quiz_2_1_1_Question_3 without arguments. Your task is to finish by typing the PD controller contained in the pitchController.m. Keep a kd_phi = 5. What value of kp_phi the pitch within the green and red lines of the graph generated by the simulation? 5 代码如下: function Tphi = pitchController(phi,phiDesired,dphi_dt) kd_phi = 5; kp_phi = 5; Tphi= kp_phi*(phiDesired-phi)+kd_phi*(0-dphi_dt); 4.Now we will put all 3 controller parts together. To run the simulation, Quiz_2_1_1_Question_4 without arguments. In this simulation, you combine the 3 previous controllers. Can you make the robot move the way you want it? The intent of this question is just for you to get some intuition about how these controllers interact, and to have some fun seeing that very simple controllers can get the robot to move robustly. When you're done, simply enter 42 as the answer below. 42 这个题是随意题... 就是结合上面的后.自己可以控制玩玩 2.2.1 Metrics and scaling: mass, length, strength 1.If a cube's page length is doubled, what happens to its circumference, surface area and volume? Permeter:2x Area: 4x Voolume: 8x 2.A small ice cube with side length L and a larger ice cube of length 2L sits out in the sun. If the little ice cube takes 10 minutes to melt, how long will the big one take in minutes? Tip: You don't need to know anything about thermodynamics to fix this; heat transfer (the rate at which ice cube is heated) is proportional to the surface of the ice cube, and the thermal mass (the amount of heat required to melt the ice cube) is proportional to volume. We assume that the melting time is proportional to this ratio. 20 Solution: 20 -> 10 minutes * Volume / Area 这里有个英文文档解释 3.If a larger bone in a larger animal is 3x longer than a smaller bone in a smaller animal, and the pressure load in both bones is the same, how many times thicker should the larger bone be? Tip: stress is mass divided by area. Provided that the constant density of the animals is proportional to volume. Also, assume that the volume is scaled by length^3. Remember that the primary compression occurs axially along the length of the bone. How much larger does the thickness need to be to maintain the same (mass)/(cross-sectional) ratio? Correct answers must be submitted in one decimal place (e.g. 23.5) 0.11 V = 333 = 27 -> sqrt(V) = 5.19 ~ 5.2 这里有个英文文档解释 4.Pair the following scenarios with the dominant way to load: an elastic band, there the stretch end diving board gets jumped onen can stand ona bolt gets tightened 1) tensio 2) bending 3) compression 4) torsion 2.2.2 Materials, manufacture, and assembly 1.With everything else is equal (stiffness, strength, dimensions, etc.), what type of material will warm up more if stressed in voltage until failure? Ductil 2.If a 10cm diameter, 0.5 m long cylinder is filled with 20 kg mass in voltage, what is stress (force divided by cross-sectional area) in the material in Pascals (SI unit for stress: N /m ^2)? (Remember, we deal with axial tension loads) 24972.4 解释: stress = F /A; F=mg,A=pi*r^2 3.If the above cylinder then extends by 8 cm, what is (extension normalized by initial length) in %? 16 解释:0.08/0.5=16% 4.Necking is a phenomenon where plastic deformation causes significant load resulting in reduced cross-sectional area. If the above cylinder experiences necking will stress in the neck be greater or less than stress for the rest of the sample? Stock 2.2.3 Design: figure of profit, robustness 1.Question 1 Given the following material characteristics: Aluminium 6061-T6 has a density of 2.7 g/cm^3, a Youngs modulus of 69 GPa and an ultimate tensile strength of 310 MPa. ABS Plastic has a density of 1.3 g/cm^3, a Youngs modulus of 2.2 GPa and an ultimate tensile strength of 70 MPa. If a spring were to be made by pulling a 10cm long cylinder of material in tension with a desired stiffness of 5000kN/m, what should the diameter (in millimeters) be for an aluminum spring? This wikipedia page can be useful, especially the section : Force is exercised by stretched or contralicated material. 3.04 解释: F L 0 = E A Δ L FL_0=E A \Delta L FL0 =EAΔL,A是底面积,F力,E杨氏模量 2.If the spring were to be made of ABS plastic instead, what should the diameter be (in millimeters)? 17.01 3.What would be the mass of aluminum spring (in grams)? 1.96 解释:质量 = 密度 * 体积 4.What would be the mass of plastic spring (in grams)? 31.97 5.If the aluminum spring was pulled 3mm, would it break? Yes 6.If the plastic spring was pulled 3mm, would it break? No 2.3.1 Actuator technologies 1.Which of these tasks depends to a large extent on high actuator bandwidth (frequency at which the actuator can work well)? High speed pick and place One-legged robot capture itself after a tripping 2.The speed of torque curve establishes a correlation between these two physical properties of electric motors. Since power is a product of torque and angular speed, where does maximum power happen? At 1/2 no-load speed 3.Torque in an electromagnetic actuator is proportional to the flow of the constant K t K_t Kt (in Nm/A, often specified by engine manufacturers). The dominant form of wasted energy in these actuators is due to Joule heating, which scales with power squared. Where does maximum wasted energy occur? At the stall (no speed) 4.In the above chart, if both arrows are held firmly and the position of the central node is x x x and its speed is v v v, what is the differential equation representing this system? Suppose spring has rest length x 0 x_0 x0. F + b v = k (x − x 0) F+bv=k(x-x_0) F+bv=k(x−x0) UGE 3 1.Download and extract the attachment. Using MATLAB, open the Q1 folder and edit computeForwardKinematics.m and calculate forward kinematics for a single revolutelink that replaces the trivial solution (x=0, y=0). Then run singlelinkforward.m To verify that this is correct, drag the slider to ω 1 = 2 \theta_1 = 2 ω1 =2what is the x coordinate of the end effector? Suppose L 1 = 1 L_1=1 L1 =1. -0.41 2.Use MATLAB, open the Q2 folder, and edit computeRRForwardKinematics.m and calculate forward for a revolute-revolute robot that replaces the trivial solution for both the elbow (joint connecting L 1 L_1 L1 and L 2 L_2 L2) and end effector (orange dot). To check that this is correct, run rrForward.m and drag the sliders to ω 1 = 1 \theta_1 = 1 ω1 =1 and ω 2 = 0.75 \theta_2 = 0.75 ω2 =0.75what is the y-coordinate of the end effector? Suppose L 1 = 1 L_1=1 L1 =1 and L 2 = 1 L_2=1 L2 =1. 1.83 3.Using MATLAB, open the Q3 folder and edit computeRRInverseKinematics.m and calculate inverse kinematics for a revolute-revolute robot. To verify that this is correct, run rrInverse.m and drag the sliders to x = 0 x = 0 x=0 and y = 1.5 y = 1.5 y=1.5 y=1.5. What is the value ω 2 \theta_2 ω2, provided that 0 < Ω 1 < π 2 0<\theta_1 <\frac{\pi}{2} 0< :1 <2π and 0 < ω 2 < 2 π 0<\theta_2 <2\pi 0<ω2 <2π? Suppose L 1 = 1 L_1=1 L1 =1 and L 2 = 1 L_2=1 L2 =1. Note: There are technically two correct configurations, but we limit the possible angles of ω 1 \theta_1 ω1 in such a way that only one of the solutions is valid. 1.44 解释:其实道理,我觉得高中学了的人都能懂... 以下仅作为参考 PS:这个需要在2019b的MATLAB下运行.不然会报错 未定义函数或变量 'eqnproblem'。 X=0; Y=1.5;%题目要求的值 theta = optimvar('theta',2) ls1 = fcn2optimexpr(@(theta)cos(theta(1)+theta(2))+cos(theta(2)), theta) eq1 = ls1 == X; ls2 = fcn2optimexpr(@(theta)sin(theta(1)+theta(2))+sin(theta(2)), theta) eq2 = ls2 == Y; prob = eqnproblem; Prob. Equations.eq1 = eq1; Prob. Equations.eq2 = eq2; show(prob) x0.theta = [0.001 0.0001];%此处是因为题目进行了大于0的约束.所以从0.0001开始 [sun,fval,exit flag] = loose(prob,x0); rads1=sol.theta(1) rads2=sol.theta(2) disp(sol.theta) 4.Using MATLAB, open the Q4 folder and edit the computeMiniForwardKinematics.m and calculate the forward kinematics for a parallel robot. To check that this is correct, run miniForwardNoToe.m and drag the sliders to ω 1 = 3.5 \theta_1 = 3.5 ω1 = 3.5 and ω 2 = 1.5 \theta_2 = 1.5 ω2 =1.5 what is the value of x? Suppose that the shorter link is of length 1 and longer link is of length 2. 1.02 3.1.2 Introduction to dynamics and control 1.A possible simplification of the dynamics of the spring-loaded inverted pendulum model (SLIP) is to neglect gravity completely. Using your knowledge of Lagrangian mechanics, which of the below equations of motion are generated from this simplification? Note: The kinetic and potential energies are given using polar coordinates. The correct answer below is in simplest form and involves a cancellation. You can assume that the radial coordinate never goes to zero. m r¨ − k (r 0 − r) − m r ά 2 = 0 ṙ + 2 ṙ ά = 0 \begin{array}{l} m\ddot r - k({r_0} - r) - mr{{\dot \theta }^2} = 0\\ r\ddto \theta + 2\dot r\dot \theta = 0 \end{array} mṙ−k(r0 −r)−mrά 2=0rά+2ṙ ω =0 2.Which of the following PD controllers – used to directly give motor commands u – is implemented correctly to the goal of the engine gardens to track the desired state? Let the desired state is given by the lowered des, the proportional shall be given at kp and the derivatives period is given by kd. u = k p p ω d s − ά) + k d (ω d e s − ȧ) u = {k_p}({theta _{des}} - \theta) + {k_d}({\dot \theta _{des}} - \dot (theta) u=kp (ωdes −ω)+kd (ω des −ω) 3.PD control allows the engines to add stiffness (via the P-term) and damping (via the D-term) in different directions. Often when you control the robot leg it proves useful to have these directions adapt to some coordinate system at the foot. For example, you might want the motors to make the leg seem very stiff when the foot pushes towards the ground in a vertical direction, but not so much in a horizontal direction. Suppose a 2 degree of freedom leg activated by 2 engines. Which of the following equations is a PD controller that allows motor commands to track a desired x and y foot position so that leg stiffness and damping can be independently controlled in the x and y direction? Tip: It may be useful to review the end of the kinematics section, which shows how forces at the end effector are mapped to engine torques. Let J J J be the kinematic Jacobian, mapping motor speeds in toe speeds. Let k p x k_{px} kpx , k p y k_{py} kpy be x x x and y y proportional gains, and k d d x k_{dx} kdx , k d y k_{dy} kdy be x x x x and y y derivative gains. u = J (k p x (x d e s − x) + k d d x (x d e s − x) k p y (y d e s − y) + k d y (y d e s − y)) u = J\left({\begin{array}{cc} {{k_{px}}({x_{des}} - x) + {k_{dx}}({{\dot x}_{des}} - \dot x)}\\ {k_{py}}(y_{des}} - y) + {k_{d}}{dy}}({{\dot y}_{des}} - \dot y)} \end{array}} \right) u=J(kpx (xdes −x)+kdx (ẋ des −ẋ)kpy (granted -y)+kdy (ẏ des −ẏ)) 3.2.1 Sprawled posture runners 1.Assume the center of the mass (CoM) is at (0.0) (0.0), left corner is on (-1.0), the bottom is on (1.-1), and the top is on (1.1). What is d 1 d1 d1? Enter 3 decimal places. 0.447 解释:大家在草稿纸上画图.然后同面积底x啦... emm具体是1/根号5 2.The lecture introduced the idea of a support polygon (see figure below and [Ting, 1994] for more information). The cockroach is quasistatically stable when the projection of CoM is within the support polygon at all times. On this issue and the next, we will reflect on the limits that this model imposes on movement speed. Suppose that CoM moves along a vertical line through the origin as the cockroach runs forward, and that the toe positions are attached to (-1.0), (1,-1) and (1.1), in units of cm (about right of a small cockroach). What is the maximum CoM displacement that holds a positive quasistatic stability margin (in cm)? 1 解释:这个地方就是如果三个点不动.蟑螂往前能移多少.也就是两边与y的交点长度,... 大家画下三角形在坐标轴的图就t道我在说些啥了 3. (building the previous question) Assume that com moves along a vertical line through the origin as the cockroach runs forward, and that the toe positions are attached to (-1.0), (1,-1) and (1.1), in units of cm (about right of a small cockroach). Assuming that the step frequency and the work cycle are such that each tripod is maintained for 0.5 seconds, what is the maximum speed so as to guarantee stability (in cm/s)? cm/s)? 解释:如果能移动1cm,而时间是0.5s,所以最大是2cm/s 4.In this question you'll think about if RHex's C legs are better or worse than stick legs for a vertical jump. Imagine the two leg designs on a vertical rail and frictionless floor (as shown above); the legs rotate in the direction of the red arrow and the body is propelled upwards. Recall Gavin's lecture on effective mechanical advantage (EMA) from 3.1.1. Which of these curves roughly captures the EMA versus height trend for each leg? Tip: You don't have to calculate kinematics. Think about how much the hip joint rotates per vanishingly small displacement in the height of the robot as a function of height. Start with stick legs. green - half circle legs, blue - stick legs 1.First see this gif (you can also save it to your computer or see here if it doesn't play) of my foster kitten performing a gait transition. Trot to gallop 解释:这几个都好好看视频就道了 2.This ostrich is a: Digitigrade 解释:鸵鸟是啥种类的动物 ... 3.From the proof of these transport costs (CoT) plot of animals and robots from MIT, which of these is a more effective form of movement? Swimming 4.From the proof of this CoT plot of animals and robots from MIT, how much power is a human running at 3m/s consuming (in Watts)? 743 解释:CoT=metallicbolic power/(mgv),也就是 P o w e r = 80 × 9.8 × 3 × 1 0 − 0.5 Power=80\times 9.8\times 3\times 10^{-0.5} Power=80×9.8×3×10−0.5 3.2.3 Bipeds 1.You have seen the SLIP model a few times now. You may have noticed that this model does not allow a biped to stand still (recall reverse pendulums from 1.2.3). What additional activation/pendant is needed for a monoped (sagittal projection of a biped) to stable stand? (There may be more than one correct answer, and assume that multiple answers are independent of each other, i.e. A OR B and not A and B) Ankle torque An activated tail attached to the hip (but not allowed to touch the ground) A tail allowed to touch the ground 2.How many degrees of freedom (DOFs) have sagittal Jerboa (model above) have in position (the toe is attached to the ground)? Photo from De and Koditschek [2015b] Tip: First, count the total unlimited DOFs for Jerboa, including (x , z) (x, z) (x,z), ben-DOFs (ω 1,ς,2) (\theta_1, \theta_2) (ω1,ά2) and orienteering DOFs (φ 1, φ 2) (φ_1,φ_2) (1φ,φ2). In attitude, you need to consider the two limitations imposed by the fact that the toe is attached to the ground. 4 3.How many non-degenerate * degrees of freedom (DOFs) have sagittal Jerboa (model above) have in flight (massless legs)? * We call a DOF with zero apparent inertia (such as a massless end effector on an activated joint) degenerate, since theoretically any actuator torque would cause infinite acceleration. Image from De and Koditschek [2015b] Tip: Start from the total DOFs in the unlimited Jerboa (as in the previous question), but now eliminate the DOFs that have zero mass associated with them. 4 Single stabilized SLIP (MATLAB) 1.In following cartoon robots, a codes measures angle relative to the body, and an IMU measures absolute body angle. In this cartoon robot, provided that control input is desired leg angle, which sensors should be used to implement the simply stabilized controller? (Keep in mind 'disk body' has no degree of freedom) No 2.In this cartoon robot, what sensors are needed to implement the Raibert stepping controller (from week 2)? Encoder 3.In this cartoon robot, provided that control input is desired leg angle (relative to the body), which sensors are needed to implement the simply stabilized controller? IMU 4.In this cartoon robot, provided that control input is desired leg angle (relative to the body), which sensors are needed to implement the Raibert stepping controller? IMU Encoder 5.In attached zip file, you will find a MATLAB GUI (run slipHW.m). In the GUI that appears, enter the parameters through the input boxes (as described below), and click run to run the simulation and present results. You will find a simplistic implementation of SLIP with a tunable fixed stepping angle. You will change the value of the stepping angle (in radians) to get a sense of the basin of this simple controller. What is a valid stepping angle (in units of radians) for speed 0.5 m/s? Tip: change the stepping angle until there are persistent bounces, i.e. stride-to-crotch apex z z and speed x \dot x ̇ shouldn't change much. A close enough answer is sufficient. Tip 2: The correct answer is between 0.12 and 0.14 radians, and you may need to go down to ± 0.0001\pm 0.0001 ±0.0001 radians of precision to make it work. This question is meant to convey how small the basin of the fixed stepping angle controller really is! 0.1294 6.Experiment with a few more values of speed, and find a good stepping angle. Which of the following plot trends represents the stepping angle – the speed ratio well? NOTE: Enter gray, green, blue, or red (not with quotes). blue WEEK 4 1.In the performance of this sequential composition, how many controllers should be sequenced for introductory point x 1 x_1 x1? (enter a numerical answer) 2 2.In this scenario, Φ1 makes the target an attracting fixed point. Which of these is a correct reason why controllers Φ2 and Φ3 are needed in addition? Basin Φ 1 Φ_1 Φ1 is not big engough 3.Why is Φ 3 → Φ 1 Φ_3→Φ_1 Φ3 →Φ1 not a valid sequential composition? The Basin Φ 1 Φ_1 Φ1 does not include the target of Φ 3 Φ_3 Φ3 4.2.1 Why is parallel hard? 1.Which of these is a template for a trotting horse? Tip: This is a review of previous material, specifically around 1:30-2:30 of lecture 2.1.1 where Jeff introduces templates SLIP 2.Recall from lectures de-coupled RL-RC circuit (R 21 = ∞) (R_{21} = \infty) (R21 = ∞) where x ̇ = A x \dot x = Ax x ̇ =Ax, and A A A A is a 2x2 diagonal array with the values A 11 A_{11} A11 and $A_{22}. What is the solution x 1 (t) x_1(t) x1 (t) if you start at t = 0 t=0 t=0? x10 to x 1 (0) x_1(0) x1 (0), x20 for x 2 (0 0 x_2(0) x2 (0) and A11 for A11 A_{11} A11, etc. To specify e x e^x ex, use exp(x). Tip: for those who need a refresher on ODEs, you may find this useful. x10exp (A11t) 3.Which of these is why the heavy toe simulation of Raibert jumps fail? The stepping controller affects the track 4.2.3a RHex 1.Why was RHex designed to have an actuator per hip? To have sufficient robot specific power (power/mass) 2.Which are some of the steps that needed to be taken to anchor a pogo stick on RHex (referred to as tuning in the lecture)? Compliance (rigidity sizes) had to be set The clock had to be set correctly 4.3.1 Compositions of vertical funnels 1.How many virtual legs are used in a quadruple walk? (see: 3.2.2) 2.How many virtual legs are used by a hopping kangaroo? 3.Suppose the cartoon robot below is in position (toe is attached to the ground), and a hip torque is applied in the direction of the arrow. So 4.Assume all the virtual or physical toes are in position (i.e. attached to the ground). The arrows in the left shape are physical leg extension forces, and the arrow in the right shape is a virtual hip torque. Note that this virtual hip torque counterclockwise would result in an acceleration of the body clockwise. To apply the displayed virtual hip torque to the right, in the physical model on the left, 5.Assume the physical robot on the left is in position. The corresponding virtual leg appears in the image on the right. In this question, we think about how physical torques can move the virtual hip. Suppose that a torque in the direction of the arrows is positive. Imagine the right physical hip applying 0 Nm. Then a torque of 1 Nm applied by the left physical hip moves the virtual hip to the left. Similarly, if the left hip applies -1 Nm and the right hip applies 0 Nm, the virtual hip moves to the right. Which of the following would translate the focal point of the virtual hip on the left? MATLAB: composition of vertical funnels 1.We have made a very simplified MATLAB simulation with a Minitaur-like body and a composition of identical, independent vertical funnels. This means that in the simulation, each leg is controlled as if it were a vertical funnel, and the controllers are really disconnected. The following questions should help you see the strength of this kind of composition, and also how body design can affect behavior. u X 2.Select d=0.2d=0.2 and leave it to the following three questions. Increase the gain from 0, by d = 0.2d = 0.2, find the minimum value of vertical funnel gain such that both vertical funnels have persistent bounces. Tip: look at hybrid fashion plot; 3 means that both legs are in position. Make sure that the system does not settle into mode 3 after a few rejections; states that are not 3 (when one of the vertical funnels has an antenna phase) is visible until the end of the simulation. 12 3.With d=0.2d=0.2, find a value of the VH gain, thus demarcation takes place, i.e. and there is no dual position (i.e. hybrid mode does not reach 3 after a few initial bounces) 30 X 4.With d = 0.2d = 0.2, what is the value of VH win such that the equilibrium zz (of CoM) is \approximately 0.2≈0.2. 36 5.Now we shall see how body dynamics (specifically, as parameterized by the length of the body) affect our composition. Switch to d=0.1d=0.1 and leave it to the following three questions. With d = 0.1d = 0.1, find a value of vertical funnel gain such that the demarcation occurs, i.e. the vertical funnels come out of sync and there is no dual position (i.e. hybrid mode does not reach 3 after a few initial bounces). Note: You will notice that the shorter body does not like passively desynchronising the vertical funnels as well as longer body ... tells us that more active desynchronization is needed (not implemented in this simulation). 15 X 6.With d=0.1d=0.1, what is the value of vertical funnel gain such that the equilibrium zz (of CoM) is \about 0.2≈0.2? Note: It may fluctuate around this value unless you run the simulation for an extended period of time, but try guessing the steady-state value it converges to. 40 4.3.2 Same composition, different bodies 4.3.3 Same body, different compositions 1.The inertial conversion template plant (pictured below) dynamically only has 1 DOF, due to angular momentum preservation 2.Suppose that we change the template plant for inertial conversion and pin the body away from CoM. Gravity is present. How many DOFs does this system have? 2 4.3.4 Transitions 1.To get an idea of the ground reaction complex (GRC), take the example of a nn-legged stool being dropped to the ground, and assume that as it falls, contacts can be made but never broken (i.e. if a leg touches the ground it does not lift out again), and also that there are no simultaneous contacts. Define sitting mode as the one where all legs are in contact. Define the term words as a sequence of contact modes in a transition function. For example→→111111111→111→, for example, is the following: For further reference to the vocabulary analogy take a look at How many possible words are there from antenna to sit for n = 2n = 2? 2 2. (Same setup as previous question) How many words are there from antenna to seated for n = 3n = 3? 6 3.De three digits inside the robot is a binary string representing the current contact state, with 1 meaning an active switch, and 0 and inactive one. If LB = left body, RB = right body, T = toe, the correct sequence of labels is LB, T, RB 4.First see this jump (you can also save the gif to your computer) Provided that contact labels are in the order {nose, leg, behind, tail}, which of these is the correct completion of the jump word corresponding to the video clip? 1010→1011→1001→1101→0101→ Tip: think about which contacts are the last to break? 0001→0000 点赞 2 收藏 2 打赏 打赏 Kin__Zhang 你的鼓励将是我创作的最大动力 2C币 4C币 6C币 10C币 20C币 50C币 举报 关注 One-click triple like Mark follows blogger, keep up to date with TA's latest blog post © 2020 CSDN Skin Theme: Great White Designer: CSDN Official Blog Home Return Home

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