Animation & Robotics

Questionnaire Solution

1. **What is the first order optimality condition for a function in multiple dimensions?**

A - The first order optimality condition is that the gradient of the function must be zero at the optimal point. Mathematically, for a function the condition is .

1. **What is the purpose of the line search routine in optimization?**

A - The purpose of the line search routine is to find an appropriate step size that sufficiently decreases the objective function along a given search direction. It does compute the direction of the search.

1. **What does Newton’s method find?**

A - Newton’s method finds the critical points of a function, which can be local maxima, minima, or saddle points. It is particularly used to find roots of a real-valued function.

1. **Write down Hooke’s law**

Hooke's law states that the force needed to extend or compress a spring by some distance is proportional to that distance. Mathematically, , where is the spring constant.

1. **A physical system will always reach a state which…?**

A - A physical system will always reach a state which minimizes its potential energy, assuming no external forces act upon it.

1. **What are the three common deformation metaphors?**

A - The three common deformation metaphors are; Point, Skeleton and Cage.

1. **What does LSCM minimize?**

LSCM (Least Squares Conformal Maps) minimizes the angle distortion in the mapping, preserving the conformality of the surface.

1. **Name the two-sampling based path planning algorithms mentioned in class.**

▪ Random Tree(RT) : Doesn’t Explore well.

▪ Rapidly Random Tree (RRT) - Rapid Exploring but it is not OPTIMAL

▪ Rapidly Random Tree \* (RRT\*) - closer to optimal solution, it takes High time

Complexity.

▪ Probabilistic Roadmaps (PRM) - Not optimal and Clusters.

1. **What are the inputs and outputs for forward kinematics?**

Inputs: Joint parameters (angles, distances, etc.). Outputs: Position and orientation of the end effector in the workspace.

1. **What is the Jacobian transpose method used for?**

The Jacobian transpose method is used for solving inverse kinematics problems, particularly for determining joint velocities that achieve a desired end effector velocity.

1. **A cube rests on the xy plane. How many degrees of freedom are needed to describe its state?**

A cube on the xy plane has 3 degrees of freedom: 2 for translation along the x and y axes and 1 for rotation about the z axis.

1. **How many angles are used in the Euler angles definition of rotation?**

Euler angles use three angles to define rotation