Whisking

Cantilever Beams as Hairs

Info Sheet

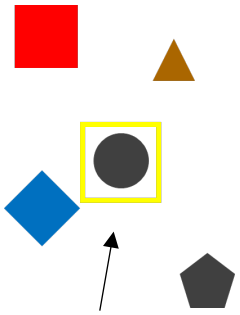
Materials Needed: *6 pipe cleaners, scissors, a pencil or pen, a surface for contact.*

Tracking Using Computer Vision Background

Computer Vision trackers are developed using many different methodologies.

Trackers unlike object identification rely on previous information in order to identify the current location of the tracked object quickly. Common previous information is the previous location and what the image looked like in the last frame.

Normally this is done by preselecting a bounding box for the tracked image. The selection of the bounding box matters for the tracker.



Bounding Box for Tracker

When picking a tracker for a specific task engineers will consider many factors including the following:

- Speed of tracking
- Minimum accuracy required
- Adverse conditions which might confuse the tracker

A few ways different trackers get confused

- If extra objects appear in the tracker bounding box.
- If the initial tracking box is too small, interesting features can be missed. In the picture if the tracking box was inside the circle a gray square could refer to the circle or the pentagon.
- If the tracked object goes out of frame.
- When the orientation of the object changes. Imagine tracking the features on someone's face and then they turn their head sideways.
- Quick movements of the object. (This is relative to what the tracker expects)

Animal Whiskers Background[1][2]

Whiskers are a type of hair called vibrissae, they are thicker than human hairs and embedded 3 times deeper in the skins surface.

Many animals with whiskers are nearly blind close to their nose so they use their whiskers similar to how you would use your hands in the dark to find your way.

[1] http://www.scholarpedia.org/article/Vibrissa_mechanical_properties

[2] https://www.discoverwildlife.com/animal-facts/mammals/how-do-whiskers-work/

Rodents and other animals will move their whiskers in a pattern called whisking in order to gain more information about their environment.

Examples of what whiskers are used for in animals:

- Seals use whiskers to detect prey moving near them. They do this because the movements of the prey changes the flow of the currents around (these are called hydro dynamic trails).
- Some of the hairs on bats are considered whiskers and are used to help stabilize them during flight.
- Cats use whiskers to find out if they can fit in tight spaces.
- Horses use their whiskers to see just in front of their nose where they are blind.

Whiskers in research are modeled as many cantilever beams connected by springs. The damping in the whiskers is modeled to be very high.

Whiskers are flexible that means they bend. Some whiskers (like rodents) are tapered that means they are elongated conical shapes. Other whiskers undulate in thickness but average out to a constant thickness (seals).

When whiskers are trimmed in animals they become partially blind until the whiskers grow back.

Whisker Thickness Experiment

For this part you will need 3 pipe cleaners, scissors and a surface for contact.

1. Take the longest pipe cleaner (12”), and bend it every 3”. Fold together (fold down once, and then again) then twist 3 of the sections together (making them triple thick). Make a ring with the last remaining section. This ring will slip over your finger.

2. Take another pipe cleaner and cut it to a length of 9”, bend every 3”. Fold together (fold down once), then twist 2 of the sections together (making them double thick). Make a ring with the last remaining section. This ring will slip over your finger.

3. Take another pipe cleaner and cut it to a length of 6”, bend in half. Make a ring with one of the halves. This ring will slip over your finger.

- Now you should have 3 “b” shaped “whiskers”. Bring down each of the whiskers over the edge of your surface, noting the difference in sensation for each thickness.

- One by one place each of the whiskers between two of your fingers. First, make contact with your object (wall, desk, table, text book) with your eyes open.

- Repeat the contact test with your eyes closed slowly bring the whisker closer to the object. Stop when you are sure the whisker is touching the object. Then open your eyes and see how much bend is in the whisker during contact.

What difference did you feel, if any between the three whisker thicknesses?

Expected Results: The thicker whiskers should transmit the forces better to the two fingers.

Whisker Distance Experiment

For this exercise you will use 1 of the pipe cleaners, and a solid surface for contact.

1. Take a pipe cleaner (12") and bend it 3" in from the end. Make a ring with this 3" section. Fold the remaining part of the pipe cleaner in half and twist together (double thick). Slip the ring over your finger.

- Please keep your eyes open the first time you touch the pipe cleaner to the object when doing the contact test closest to the base. Also move slowly.
- Place the pipe cleaner between two of your fingers. First, make contact with your object (wall, desk, table, text book) with your eyes open.
- Repeat the contact test with your eyes closed slowly bring the whisker closer to the object. Stop when you are sure the whisker is touching the object. Then open your eyes and see how much bend is in the whisker during contact.
- Repeat at three different distances

What difference did you feel, if any between the three whisker thicknesses?

Expected Results: The closer to the base a force is the easier it should be to feel a force. In addition, the closer to the base the larger the angle of deflection will be for the same translation of the whisker at the contact location.

Recognizing Contact Conditions in Whiskers

For this exercise you will use the pipe cleaner "whisker" from the previous experiment and a solid surface for contact.

1. With the ring on your finger, apply contact to the tip of the pipe cleaner. When whiskers undergo contact the part of the whisker closest to follicle will remain perpendicular to the follicle. This can also be observed in the pipe cleaner.

2. The second type of contact is the contact that occurs when the whisker brushes by an object. To replicate this you can bring a finger by the edge of the whisker tip which will cause the whisker to oscillate showing dynamic contact.

- This will be easier to do with the doubled over whisker as it has more structural integrity.

- The second type of contact is the contact that occurs when the whisker brushes by an object. To replicate this you can bring a finger by the edge of the whisker tip which will cause the whisker to oscillate showing dynamic contact.
    3. Double over a second pipe cleaner and then shape the whisker into an arc. Take the arced whisker and attempt to contact your object at more than one location. In the biological animals this rarely occurs. Almost always one single point of contact is made on the whiskers length.

Non-Contact (Airflow and Motion Caused by Movement (swimming/whisking))

Whiskers vs rigid body

While whiskers are flexible during flow whiskers have been found they are better modeled as rigid beams during non-contact. This is because of the damping of the whisker.

- Place the folded over pipe cleaner and a pen/pencil between your fingers and lightly shake them. What is the difference between the behaviors of the two cantilevers?