

Robotic Engineer - Entry/Mid Level

You have been assigned to write filters to reduce noise in the data coming from a LIDAR sensor attached to your robot. The LIDAR generates scans at a certain rate. Each scan is an array of length N of float values representing distance measurements. N is typically in a range of $\sim[200, 1000]$ measurements, and it is fixed. Measured distances are typically in a range of $[0.03, 50]$ meters. Each time a scan is received, it will be passed on to the filters. Each filter object should have an **update** method, that takes a length- N array of ranges and returns a filtered length- N array of ranges.

We want you to write two different filter objects:

- A range filter

The range filter crops all the values that are below `range_min` (resp. above `range_max`), and replaces them with the `range_min` value (resp. `range_max`)

- A temporal median filter

The temporal median filter returns the median of the current and the previous D scans:

$$y_i(t) = \text{median}(x_i(t), x_i(t-1), \dots, x_i(t-D))$$

where x and y are input and output length- N scans and i ranges from 0 to $N-1$. The number of previous scans D is a parameter that should be given when creating a new temporal median filter. Note that, although the **update** method will receive a single scan, the returned array depends on the values of previous scans. Note also that for the first D scans, the filter is expected to return the median of all the scans so far.

Here is a short example of the result (Y) of a temporal median filter object with $D=3$ for an input (X) of dimension $N=5$, for the first five updates:

T (time)	X (input scan)	Y (return of the update)
0	[0., 1., 2., 1., 3.]	[0., 1., 2., 1., 3.]
1	[1., 5., 7., 1., 3.]	[0.5, 3., 4.5, 1., 3.]
2	[2., 3., 4., 1., 0.]	[1., 3., 4., 1., 3.]
3	[3., 3., 3., 1., 3.]	[1.5, 3., 3.5, 1., 3.]
4	[10., 2., 4., 0., 0.]	[2.5, 3., 4., 1., 1.5]

You are expected to write documentation and test correctness for your code.

You can either use Python 2.7 and/or C++. For Python, Numpy library may be used. For C++, boost and stl libraries may be used.

Hi PoKang,

Your application has been reviewed by our hiring team for 2020 Summer Intern - Software Engineer, Applications position, and we would like to see a sample of your coding skills. Attached is a problem that we'd like you to solve. Please send back a zip file with your code and any build instructions as soon as possible, but within 2 weeks of receiving this email and no later than Sunday, March 8th at 11:59 PM PST.

You are free to use any reference material you choose . Please title the file as well as the primary folder with the following format: [applicant_last_name]-[applicant_first_name].

The intent isn't to demonstrate an understanding of the algorithms, but to deliver a complete solution. There is intentional ambiguity in the problem, as we would like to see your problem solving skills and creativity. All information needed to solve the problem is provided within the attachment.

If you are unable to complete the challenge within the time frame, please let us know and we will do our best to try to accommodate.

Best,
Brittany Bridges

Please submit here:

<https://app2.greenhouse.io/tests/a0707de9a5713a5cd5d0a12f7763a163>