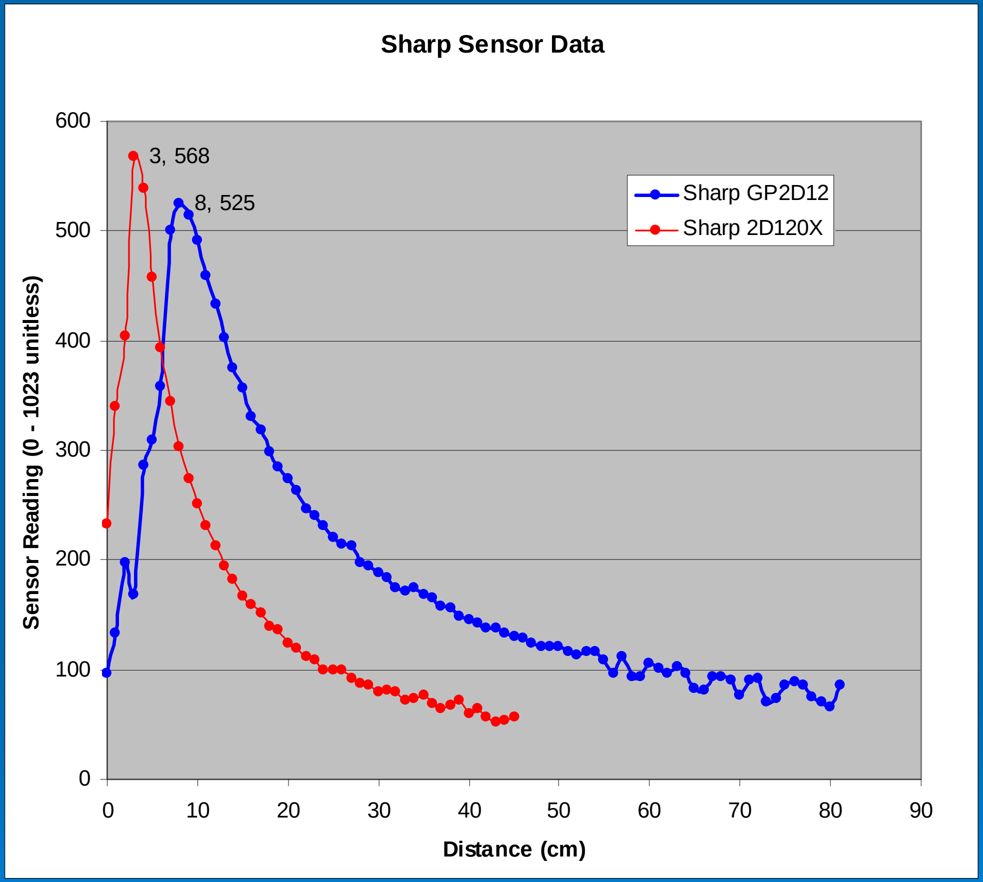
What to do about Sensor Values that are Nonlinear

Rhine/Pilla

Interactive Robotics 91.120

Raw Sensor Data



Specified Operating Range:

- 2D120X: 4 – 30 cm
- GPD2D12: 10 – 80 cm

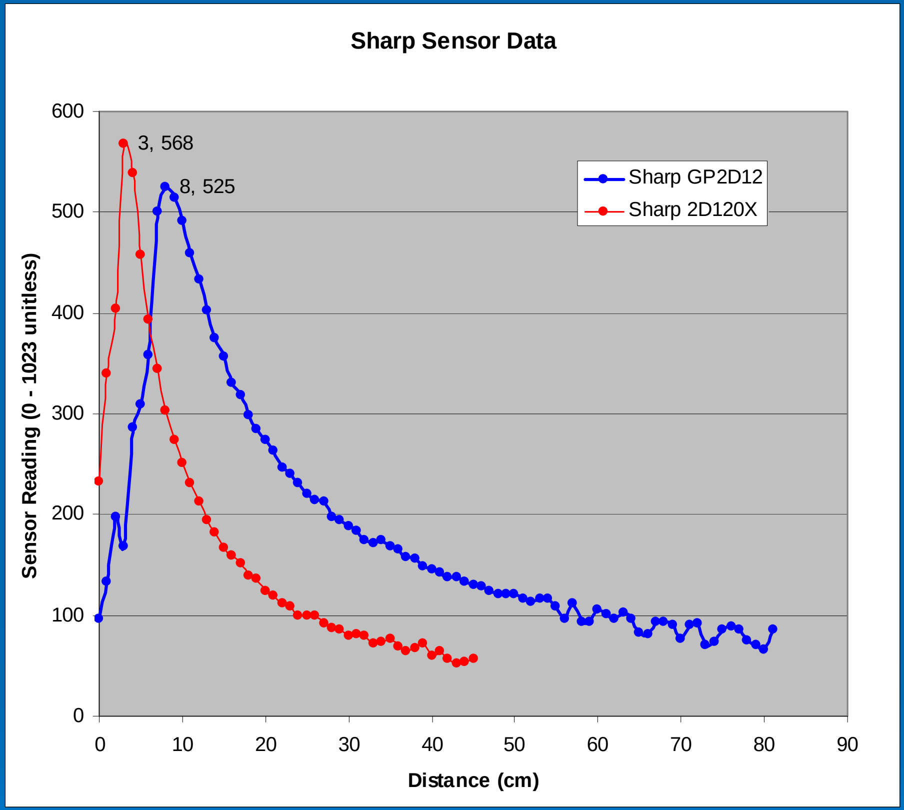
As your distance changes, the sensor reading does not change proportionally.

- You may find this trend to be useful and capitalize on it in your code (i.e., do nothing)
- On the other hand, you might want a more linear result (50% change input = 50% change in output)

How to make output linear?

- Optimally, if sensor is d = 22 cm from the target
  - Sensor would return a value of 22
  - Alternatively, return a value of K*22 (K is a constant of proportionality) (e.g. K=10 could give you a reading in mm)
- In reality, our sensor returns some other values, S(d) ("Sensor reading is a function of distance")
- Mathematically if we find the inverse function, F(x),
  - we could use the sensor values, S(d), as the inputs to F(x)
  - From algebra, F(S(d)) = __???_ if F and S are inverses of each other? Could also use other operations (e.g. multiply F & S)
  - How do you find inverse given raw data? Regression?
- Constraint: must use simple algebra
  - WinAVR/CM only allows simple integer math

Here’s what I tried…



K, a, b, and c are constants used to fit the curve above.

<u>Assumptions</u>:

- Only focus on part of curve inside specified operation range
- Curve could be exponential or logarithmic. Math is too advanced for WinAVR/CM!
- Curve could be hyperbolic – this math uses simple operations. Perhaps the form of S(d) is…

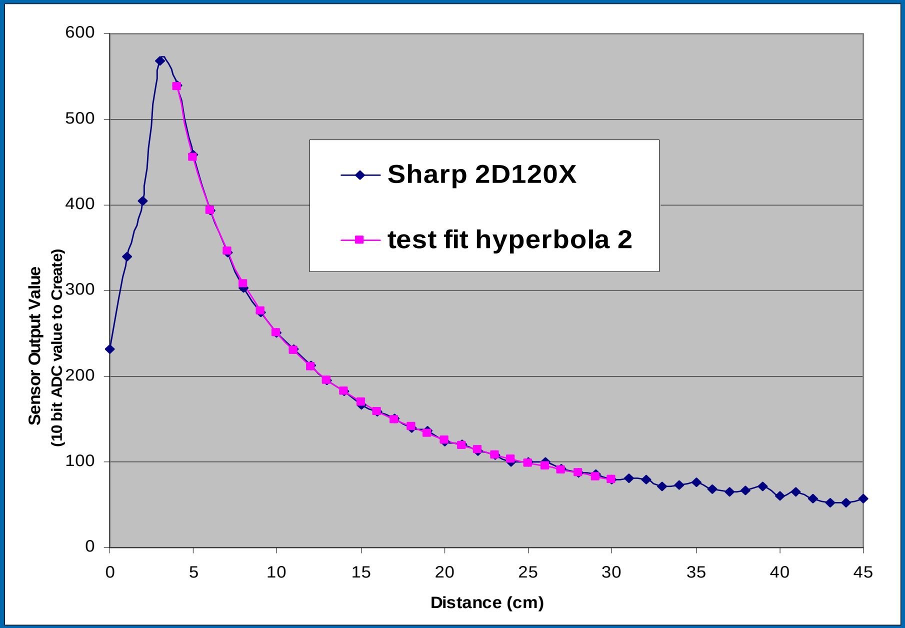
$$S(d) = \frac{k}{ad+b} + c$$

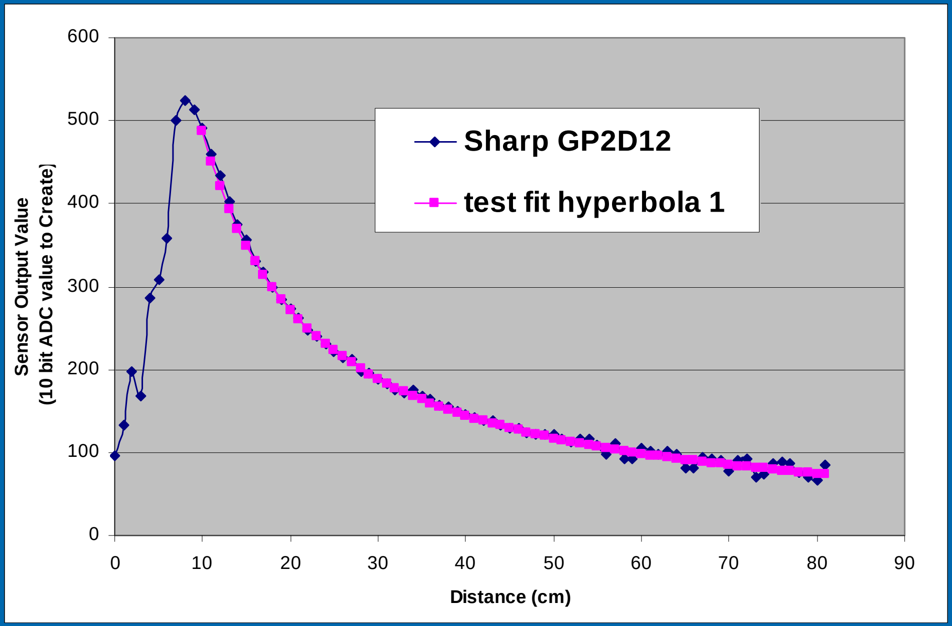
- If so, the inverse, F(s), would take the form…

$$F(S) = \frac{k - b(S-c)}{a(S-c)}$$

- Or you could also try multiplying S(x) by F(x) = ax + b to make a linear output S(x) * F(X) = Kx

Here are the test fit hyperbolas…





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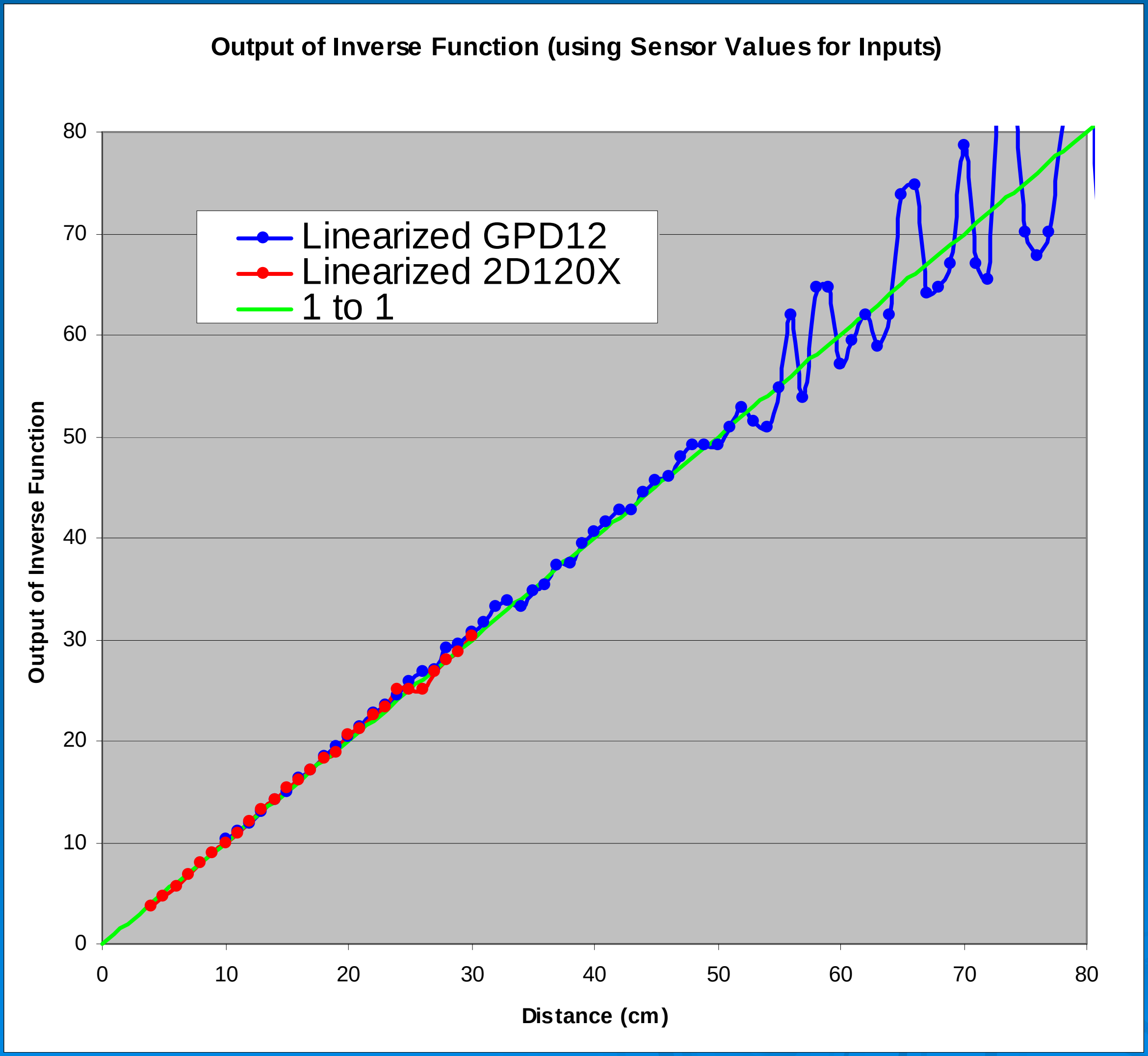
	Test Fit Hyperbola Constants:	
	GP2D12	2D120X
a	3	3
b	8	5
c	0	-20
k	18500	9500

And here is the final result…F(S(d))



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