7.6 Decision Nonlinearities

- In Sections 7.4 and 7.5, we modified the iterative linear receivers by incorporating the dec(x) nonlinearity between iterations, hoping for better cancellation and closer approach to ML.

- Here we look at dec(x) in more detail and generalize it, to prepare for the methods of Sections 7.7 and 7.8

- We have been using

$$\text{dec}(x) = \underset{b \in Q}{\text{argmin}} \; |x - b|$$

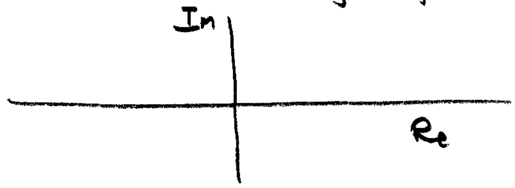
Choose the constellation point nearest x.

- If no constellation mapping imposed, as in the iterative linear methods of Sections 7.1, 7.2, then $b \in \mathbb{C}$, and min is achieved with $b = x$. Hence

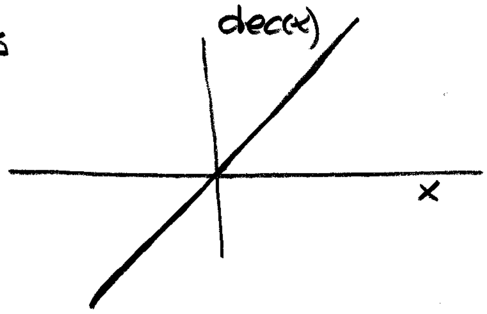
$$\text{dec}(x) = x$$

So we didn't use the dec function in those sections.

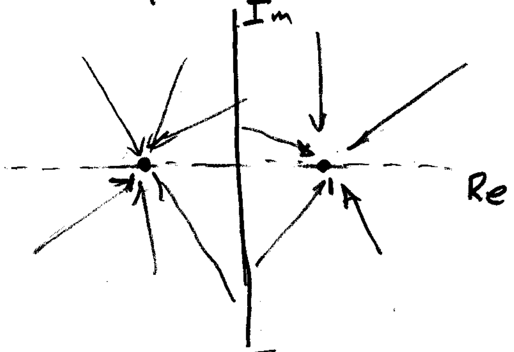
- In this case, the dec(x) function is a unity mapping of the plane to itself



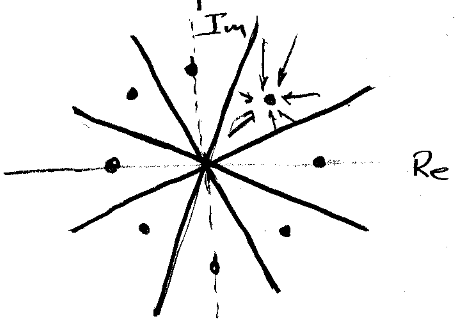
- If x is always real, then the I/O of the function is



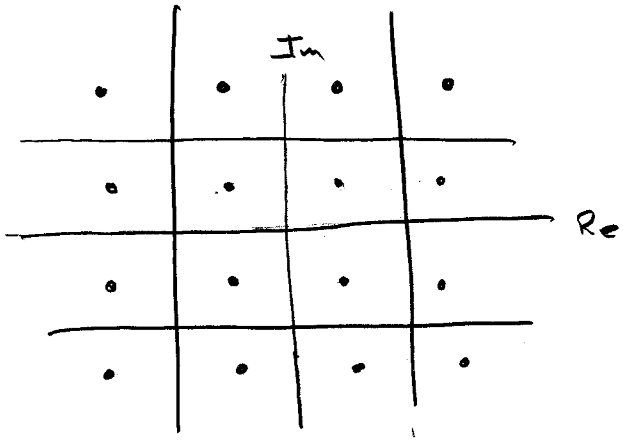
- If we have a discrete constellation, then dec(x) incorporates classical decision boundaries.



All points x are mapped onto the constellation point in their half plane



8 PSK



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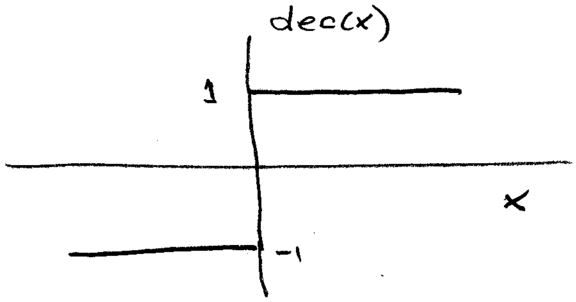
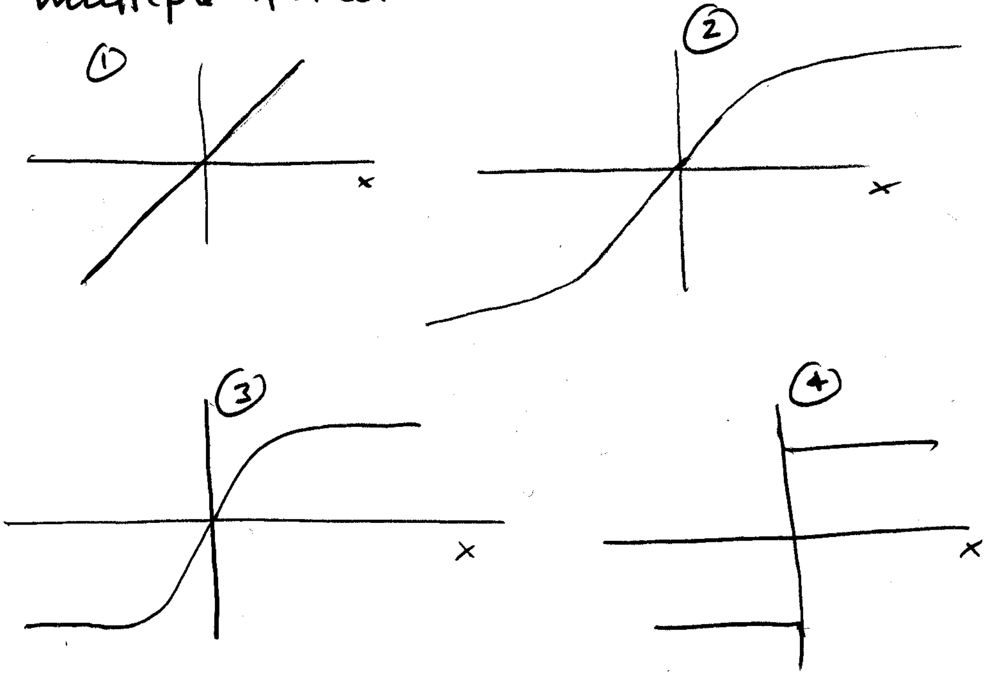
- If x is always real and it's BPSK modulation, then the I/O relation is

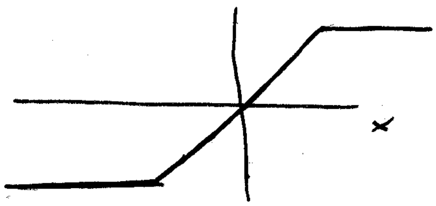


- The use of a decorrelator as the first stage of PIC (or SIC, for that matter) followed by the sgn hard limiter as second stage suggests intermediate soft nonlinearities for multiple iterations.



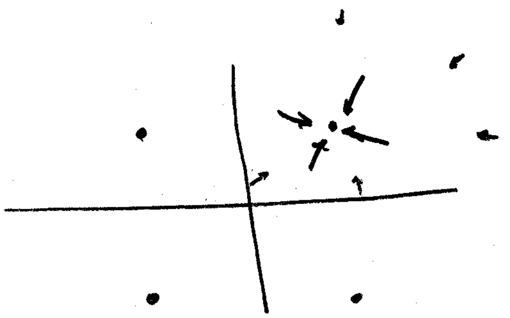
Various families of functions will do this, eg $\tan^{-1}(ax)$

Another candidate is

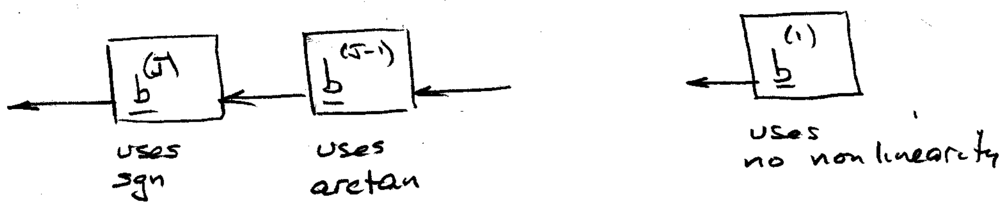


clipped soft nonlinearity

- For 2D constellations, we could construct varying degrees of "pull" from the constellation points



- The pipeline structure can use harder nonlinearities with each iteration unit



- But it all seems quite ad hoc. We need a more analytical approach to guide us.