CORDIC Accuracy Search

20160122

Greedy algorithm.

Optimal Solution

DFS/BFS

Heuristics

Cost functions

Greedy algorithm.

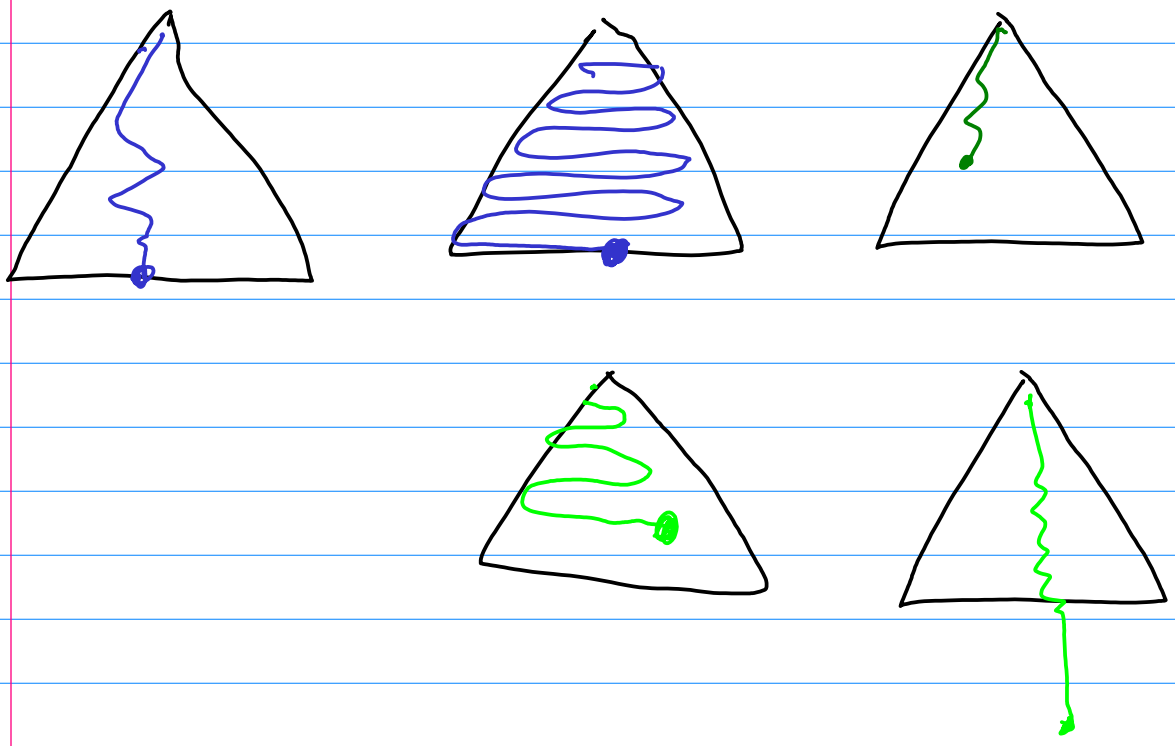
Existing CORDIC algorithms are a kind of depth first search with a given iteration constraints.

What would be the result of breadth first search with the same given iteration constraints?

What if a given iteration constraints is replaced by absolute value of residual angles?

Need to have an idea of convergence rate depending on the initial angle.

any dependency on intial angles

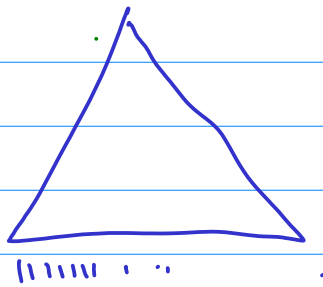


Optimal Solution, DFS/BFS, Heuristics

C++

min { sampling error + quantization error }

(I) Optimal Solution.



level l

$g(l)$
cost function

approximated uniform scale

$f(l)$

(II) DFS, BFS

(III) Heuristics ?

(a) min { sampling error }

(b) min { quantization error }

Complexity is great

need to be checked

$\cos^2\theta + \sin^2\theta = 1$

need to Check.

① Back Tracking

ⓐ Brute force, traditional backtracking

ⓑ Heuristics

avoid "dense" angle?

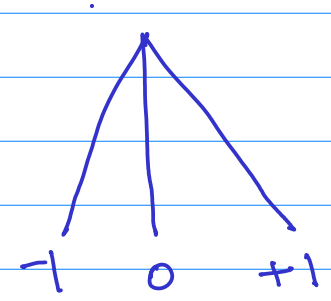
0, 45°, 90°, 135° .....

② Parallel.

③ Lookahead

④ ternary tree

after enough iterations, constant scaling problem vanishes



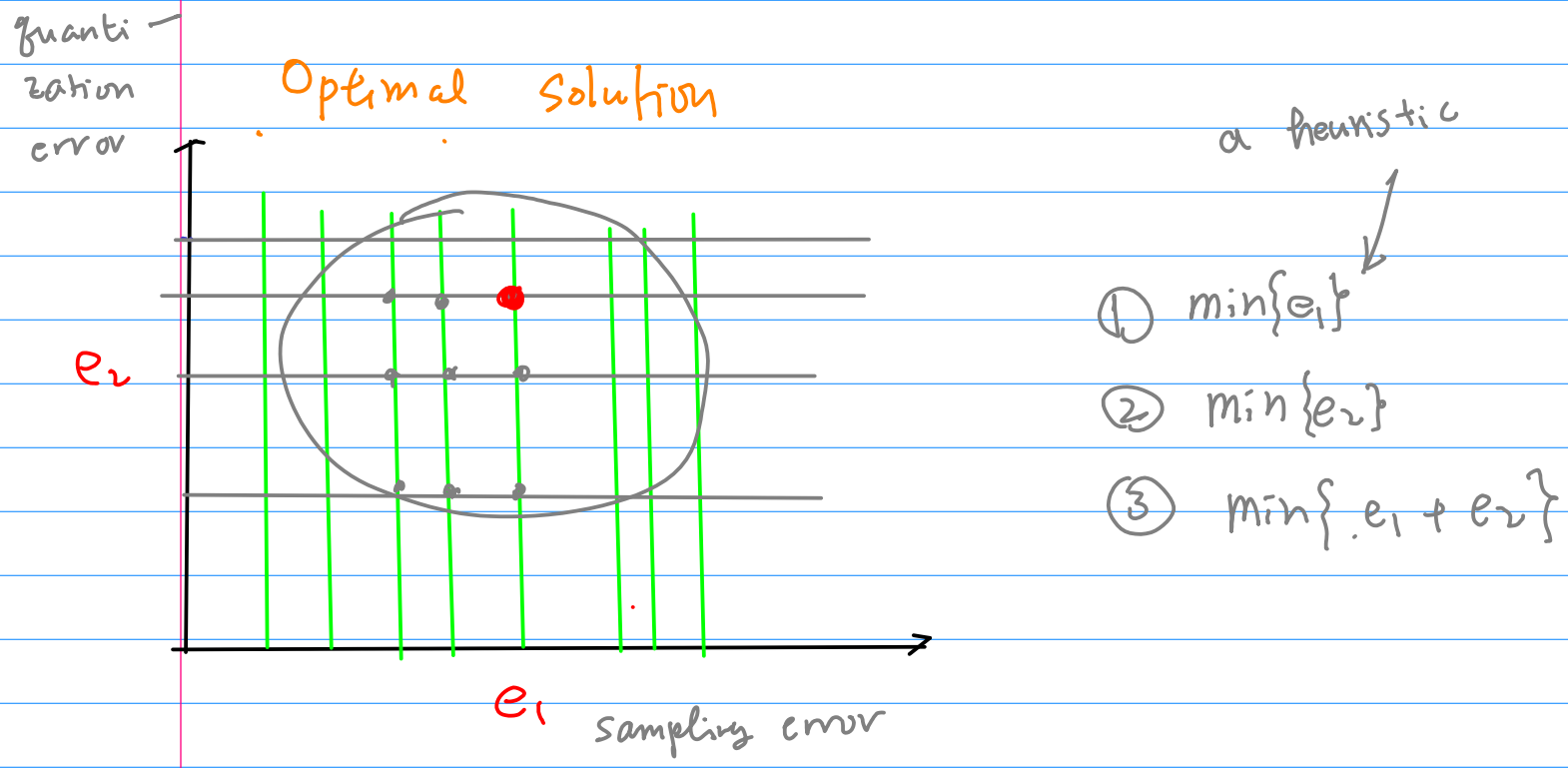
Need to check for a well know angle points how well and fast the CORDIC algorithms converge to their optimal values

What is the optimal value?

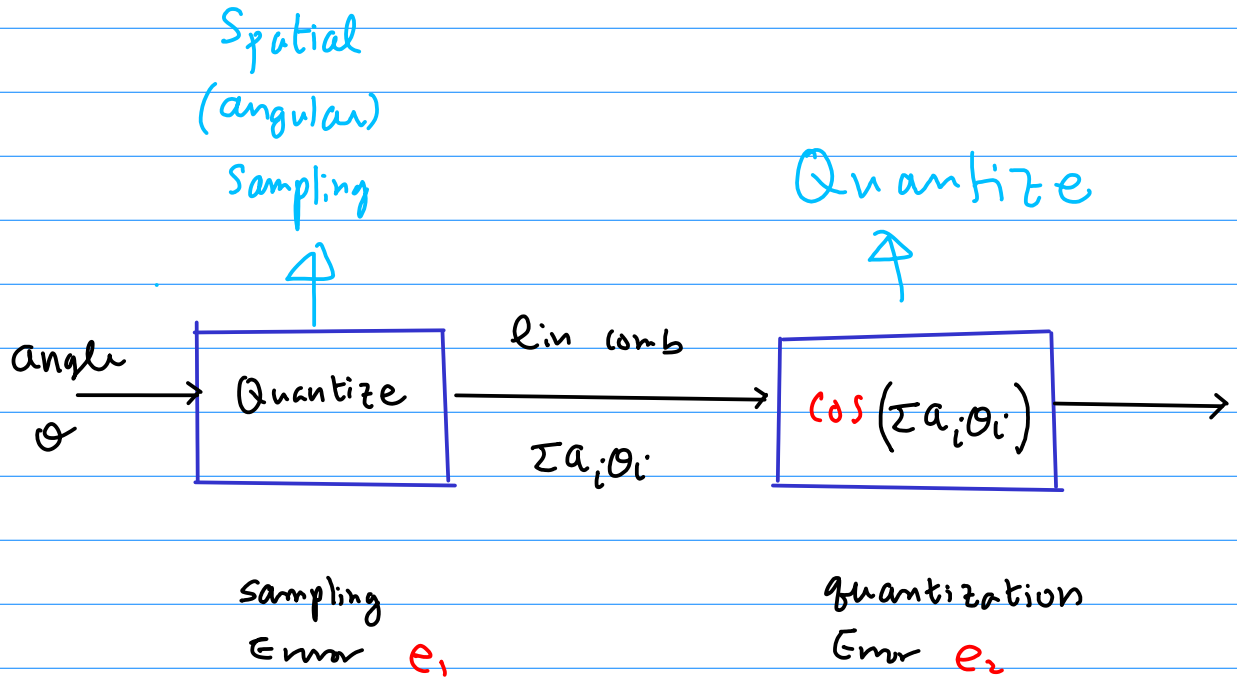
min { sampling error + quantization error }

in mean square sense

among the found (pre-computed) values



Cost Functions



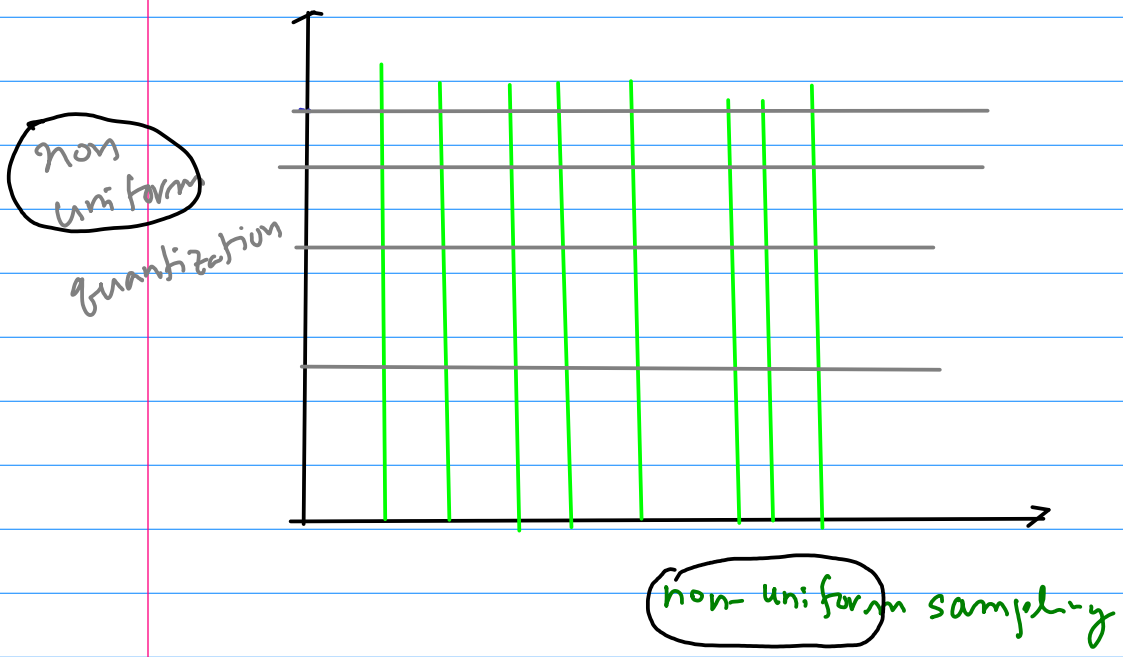
dependent but not interact

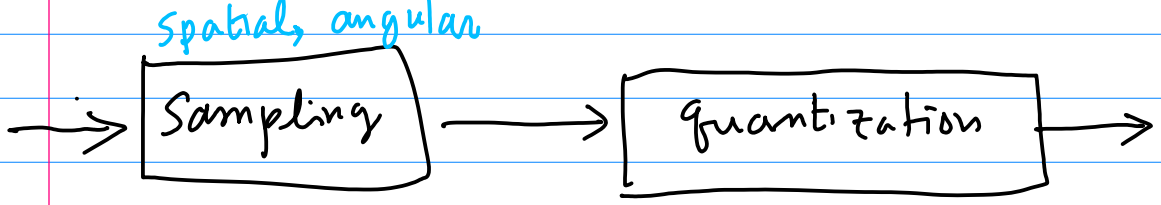
$e = f(e_1, e_2)$ additive? multiplicative?

CORDIC tries to minimize only the sampling error.

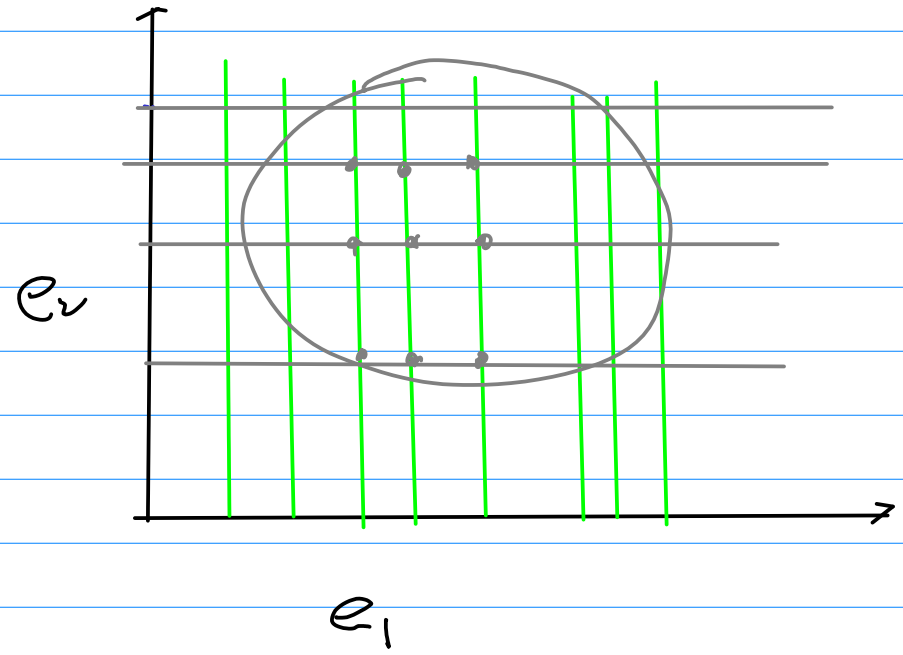
What is the optimal solution?

Min e_1 & Min e_2


non uniform quantization
non- uniform sampling


spatial, angular
Sampling
quantization

Optimal solution



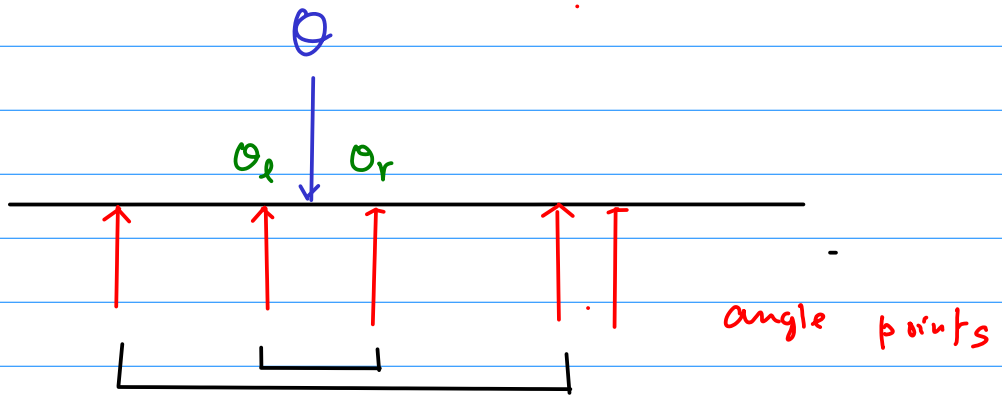
a heuristic

① $\min\{e_1\}$

② $\min\{e_2\}$

③ $\min\{e_1 + e_2\}$

eventually e



candidates of the quantized angle $\tilde{\theta}$

expression, condition

given angle ↓

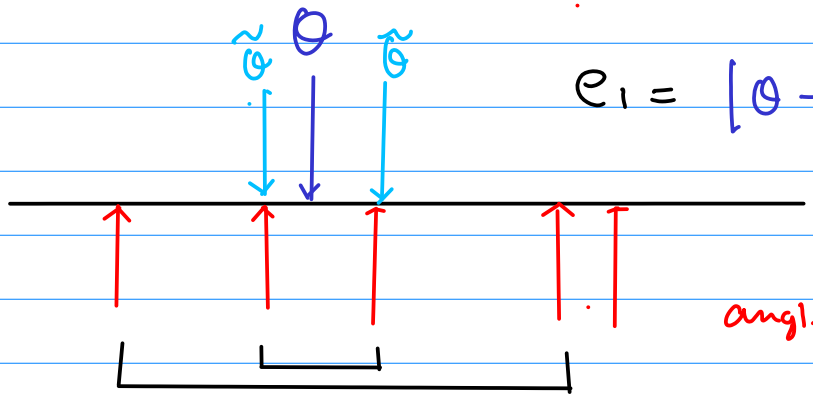
θ_l : the closest angle point that lies to the left of θ

θ_r : " " " " " " " " right of θ

- if the quantized angle $\tilde{\theta}$ is neither θ_r nor θ_l
  → BFS makes sense

- this is the probable case where θ is in the heavily populated angle points area (in the vicinity of 0°, 45°, ...)

- need to check any influence on the position of a given angle



$e_1 = |\theta - \tilde{\theta}|$

angle points