Angle Recording CORDIC
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to reduce the number of CORDIC iterations

by encoding the angle of rotation
as a linear combination of
selected elementary angle of micro-rotations

Signal / Image processing DFT & DCT
- the rotation angle known a priori

Elementary Angle Set

$S = \{ (\sigma \cdot \tan^{-1}(2^{-r})) : \sigma \in \{+1, -1\}, \; r \in \{1, 2, \cdots, n-1\} \}$

n-bit angle as a linear combination

$$\theta = \sum_{i=0}^{n-1} \sigma_i \cdot \tan^{-1}(2^{-i})$$

AR : $\sigma \in \{-1, 0, +1\}$

EAS (Elementary Angle Set) for AR methods

$S_{EAS} = \{ (\sigma \cdot \tan^{-1}(2^{-r})) : \sigma \in \{+1, 0, -1\}, \; r \in \{1, 2, \cdots, n-1\} \}$

Simple angle recording — Hu's greedy algorithm

tries to represent the remaining angle using the closest elementary angle $\pm \tan^{-i}$

- rotation mode — Angle Recording
- vectoring mode — Backward Angle Recording (BAR)

initialize $\theta_0 = \theta$

$\sigma_i = 0 \qquad i = 0, 1, \cdots, n-1$

$k = 0$

repeat until $|\theta_k| < \tan^{-1}(2^{-n+1})$ do

1. choose i_k, $\quad i_k = 0, 1, 2, \cdots, n-1$

   such that

   $$\left|\, |\theta_k| - \tan^{-1}(2^{-i_k}) \right| = \min_{i \in [0:n-1]} \left|\, |\theta_k| - \tan^{-1}(2^{-i}) \right|$$

2. $\theta_{k+1} = \theta_k - \sigma_{i_k} \tan^{-1}(2^{-i_k})$

   $\sigma_{i_k} = \mathrm{sign}(\theta_k)$