

CORDIC: Coaching Old, Really Dumb Integrated Circuits

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1 Introduction

CORDIC is an acronym for the Coordinate Rotational Digital Computer. It is a popular approximation algorithm for many functions and is a building block for floating point math that computers use today. The most relevant use cases for CORDIC are where hardware multiplication is expensive (as is the case on older and/or cheaper integrated circuits). The scope of the class today will focus on approximating trigonometric functions.

2 Derivation

2.1 Prerequisite

$$\begin{aligned}\sin(\theta + \delta) &= \sin \theta * \cos \delta + \sin \delta * \cos \theta \\ \sin \theta &= \pm \tan \theta / \sqrt{1 + \tan^2 \theta} \\ \cos \theta &= \pm 1 / \sqrt{1 + \tan^2 \theta}\end{aligned}$$

2.2 Definitions

$$\begin{aligned}K_n &= \sqrt{1 + 2^{-2n}} \\ \tan \theta &= 2^{-n}\end{aligned}$$

2.3 Proof

$$\begin{aligned}\sin(\theta + \delta) &= \sin \theta \cos \delta + \sin \delta \cos \theta \\ K_n R \sin(\theta + \delta) &= K_n R \sin \theta \cos \delta + K_n R \sin \delta \cos \theta \\ K_n R \sin(\theta + \delta) &= 2^{-n} R \cos \delta \pm R \sin(\delta)\end{aligned}$$