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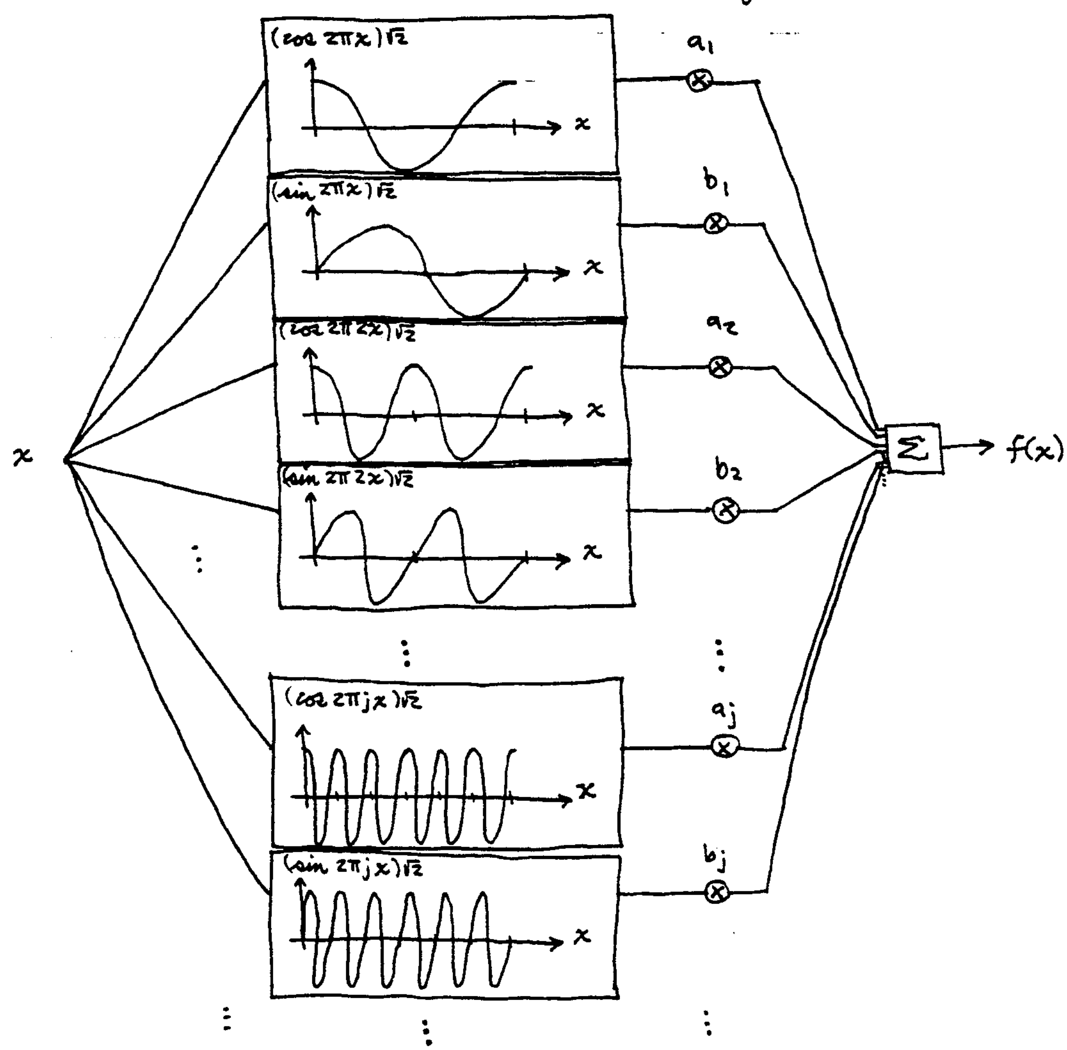
25 Mar 1994

The idea of decomposing a function into a set of weighted base functions underlies the theory of Fourier series.

Consider a one-dimensional Fourier series:

$$f(x) = \sum_{j=1}^{\infty} \left( a_j \sqrt{2} \cos(2\pi j x) + b_j \sqrt{2} \sin(2\pi j x) \right) + a_0$$

In network form we have a weighted base-function net:




The Fourier series has a number of features that make it particularly convenient to work with:

1) The base functions are actually a <u>complete set</u> of basis functions. This means that every continuous function $f$ has a Fourier

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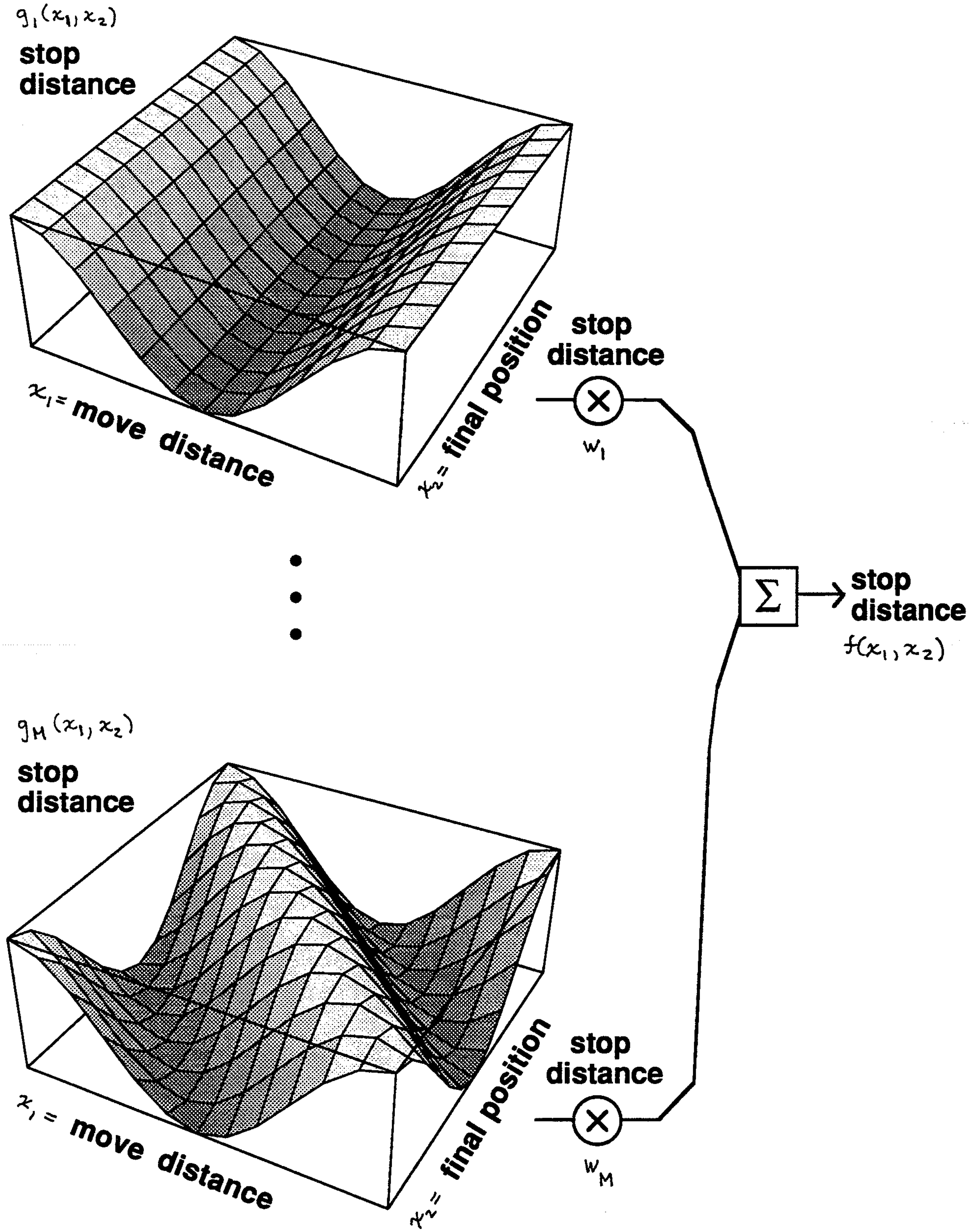
series representation, and that representation is unique.

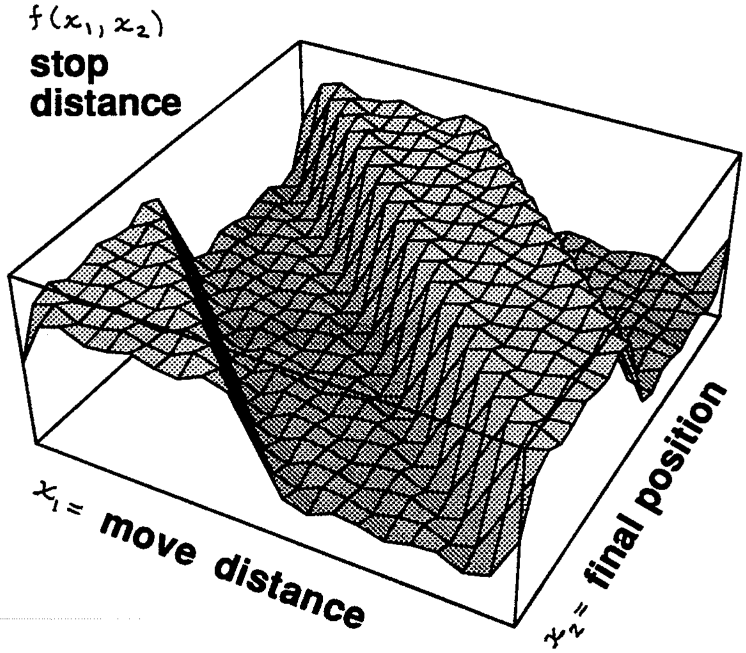
2) The base functions are <u>orthonormal</u>, meaning we can find the weights or coefficients $a_j$ and $b_j$ by taking inner products of $f$ and each base function. (See Fourier series tools.)

The following pages illustrate a 2-dimensional Fourier series base-function network applied to the motor control problem described in the overview.

# FOURIER SERIES (cont.)



# FOURIER SERIES (cont.)




Estimation of a square wave in 1-1 direction. Figure shows approximation for series truncated at three terms.