REFERENCES


List of internet resources

http://mathworld.wolfram.com/SternsDiatomicSeries.html

http://www.ifp.uiuc.edu/~minhdo/

http://pages.cs.wisc.edu/~olvi/


http://archive.ics.uci.edu/ml/datasets/SPECT+ Heart

http://archive.ics.uci.edu/ml/datasets/SPECTF+Heart;


LIST OF PUBLICATIONS

I INTERNATIONAL/NATIONAL JOURNALS


II IEEE CONFERENCES


III INTERNATIONAL /NATIONAL CONFERENCES


IV CITATIONS


3. ‘Medical Image Registration using Next Generation Wavelets’ Notes from Indian Institute of Information Technology, Allahabad.

APPENDIX A

In this appendix statements of various theorems that are used in the thesis are given. Proof of these theorems can be referred in the respective literatures cited.

**Theorem A.1 : Function approximation by linear basis function** (Kung 1993)

Let $A$ be a compact subset of $\mathbb{R}^M$ and $F(x)$ be a continuous function on $A$. Then for any $\varepsilon > 0$, there exist an integer $N$ and real constants $c_i$, $w_{ij}$ and $\theta_i$ such that

$$\left| \hat{F}(x) - F(x) \right| < \varepsilon \text{ for all } x \in A,$$

where

$$\hat{F}(x) = \hat{F}(x_1, x_2, \ldots, x_M) = \sum_{i=1}^{N} c_i f \left( \sum_{j=1}^{M} w_{ij} x_j + \theta_i \right)$$

and $f(.)$ is any non-constant, bounded and monotonically increasing continuous function.

The argument of the function $f(.)$ is a linear weighted sum of the component values, i.e., $\sum_j w_j x_j + \theta_j$. Therefore $f(.)$ is called linear basis function. In this approximation, the function $f(.)$ could be like the semi linear output function of a MLFFNN. Thus the function approximation, in principle, can be realized by MLFFNN with a single layer of hidden units and an output layer of linear units.

**Theorem A.2 : Function approximation by radial basis function** (Kung 1993)

Let $A$ be a compact subset of $\mathbb{R}^M$ and $F(x)$ be a continuous function on $A$. Then for any $\varepsilon > 0$, there exist an integer $N$ and parameters $w_i$ and $c_i$ such that

$$\left| \hat{F}(x) - F(x) \right| < \varepsilon \text{ for all } x \in A,$$

where $g(.)$ is a nonlinear function with unique maximum centered at $w_i$ (Powell 1988; Moody and Darken 1989).
The argument of the function $g(.)$ forms the basis of the function. Since the argument is the radial distance between the variable vectors $x$ from the centroid vector $w$, the function $g(.)$ is called the RBF and the function approximation is called the RBF approximation. Gaussian function is one of the commonly used non linear functions for $g(.)$. The theorems show existence of parameters to approximate any given function.

**Theorem A.3:** Approximation Theorem I (Curtain and Pritchard 1977)

Let $F$ be a bounded function on $[a, b]$, and $E = \{ x_1, \ldots, x_k \}$ a set of points in $[a, b]$, then there exists the least squares polynomial of degree $\leq n$, $p_n^k$ which minimizes

$$\sum_{i=1}^{k} |F(x_i) - p(x_i)|^2$$

over all polynomials of degree $\leq n$.

**Theorem A.4:** Approximation Theorem II (Curtain and Pritchard 1977)

If $F \in C[a, b]$, then for any $n \geq 0$, there exists a best approximating polynomial $\Pi_n$ of degree $\leq n$ such that

$$\|F - \Pi_n\|_\infty \leq \|F - p\|_\infty$$

over all polynomials $p$ of degree $\leq n$.

**Theorem A.5:** Approximation Theorem III (Curtain and Pritchard 1977)

If $F$ is a bounded function on $[a, b]$, and $E = \{ x_1, \ldots, x_k \}$ a set of points in $[a, b]$, then there exists a best approximating polynomial $\Pi_n^k$ of degree $\leq n$, $p_n^k$ which minimizes

$$\max_{0 \leq i \leq k} |F(x_i) - p(x_i)|$$

over all polynomials of degree $\leq n$. 

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Theorem A.6: Stone-Weierstrass theorem

Let domain $D$ be a compact space of $N$ dimensions, and let $F$ be a set of continuous real-valued functions on $D$ satisfying the following criteria:

- **Identity function**: The constant $f(x) = 1$ is in $F$.
- **Separability**: For any two points $x_1 \neq x_2$ in $D$, there is an $f$ in $F$ such that $f(x_1) \neq f(x_2)$.
- **Algebraic closure**: If $f$ and $g$ are any two functions in $F$, then $f \cdot g$ and $af + bg$ are in $F$ for any two real numbers $a$ and $b$.

Then $F$ is dense on $C(D)$, the set of continuous real-valued functions on $D$. In other words, for any $\varepsilon > 0$ and any function $g$ in $C(D)$, there is a function $f$ in $F$ such that $|g(x) - f(x)| < \varepsilon$ for all $x \in D$.

For the proof of the above theorem readers can refer to Jang 1997.

Theorem A.7: Schema Theorem (Holland 1973; 1992)

Above-average schemata with short defining length and low order will receive exponentially increasing trials in subsequent generations of a GA.

For a population with $N_p$ individuals the GA implicitly evaluates approximately $N_p^3$ schemata in one generation.

Theorem A.8: Building-block Hypothesis (Goldberg and Grefenstette 2005)

A GA seeks near-optimal performance by the juxtaposition of short, low-order, and highly fit schemata, called building blocks.

Theorem A.9: Continuous function approximation (Hecht-Neilsen 1988)

Any continuous real-valued mapping $f : [0,1]^n \rightarrow \mathbb{R}^m$ can be approximated to any degree of accuracy by a feed forward ANN with $n$ input nodes, $2n+1$ hidden units and $m$ output units.