A Locally Parameter Element Wise Linear Transformations (Interpolation) Based Forecasting Model For Dynamic State Systems With Large Number Of Parameters

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Abstract

In this research investigation, the author has presented '*A Locally Parameter Element Wise Linear Transformations (Interpolation) Based Forecasting Model For Dynamic State Systems With Large Number Of Parameters*'.

Theory

Firstly, we represent any *Dynamic State System* using a *State Vector* (*Row Vector*) of a specified size, say

$$V_i = [V_i(1) \quad V_i(2) \quad V_i(3) \quad . \quad . \quad . \quad V_i(n-2) \quad V_i(n-1) \quad V_i(n)]$$

That is,

$$\overline{V_i} = [V_i(1) \quad V_i(2) \quad V_i(3) \quad . \quad . \quad . \quad V_i(n-2) \quad V_i(n-1) \quad V_i(n)]$$

$$\overline{V_i} = \sum_{j=1}^{n} \{[V_i(j)]\hat{e}_j\}$$

Here, the *State Vector* has n parameters that are Evolving with time.

For the time instant $i = k$, we have the *State Vector* given by

$$\overline{V_k} = [V_k(1) \quad V_k(2) \quad V_k(3) \quad . \quad . \quad . \quad V_k(n-2) \quad V_k(n-1) \quad V_k(n)]$$

Let the *State Vector* be defined for $i = 1$ to $i = m$ instants.

We now *Normalize* all $\overline{V_i}$ for $i = 1$ to $i = m$.

The *Normalization* is given by

$$\hat{V_i} = \frac{\overline{V_i}}{\left\{\sum_{j=1}^{n} [V_i(j)]^2\right\}^{1/2}}$$

That is,

$$\hat{V}_i = \frac{\sum_{j=1}^{n} \{[V_i(j)]\hat{e}_j\}}{\left\{\sum_{j=1}^{n} [V_i(j)]^2\right\}^{1/2}}$$

We now define $T_{s\to(s+1)}(j) = \frac{\hat{V}_{(s+1)}(j)}{\hat{V}_s(j)}$

If $\hat{V}_m(j)$ is closest to some $\hat{V}_u(j)$ when we run u through $1 \le u \le m$

Case 1:

We re-write $\hat{V}_u(j)$ as $\hat{V}_{u_j}(j)$ just to clarify that for every j , u may be different.

$$\hat{V}_m(j) > \hat{V}_{u_j}(j)$$

We define

$$\hat{V}_{m+1}(j) = \{\hat{V}_m(j)\}\left[\frac{\hat{V}_m(j)}{\hat{V}_{u_j}(j)}\{T_{u\to(u+1)}(j)\}\right]$$

We now have

$$\hat{V}_{m+1} = [\hat{V}_{m+1}(1) \quad \hat{V}_{m+1}(2) \quad \hat{V}_{m+1}(3) \quad . \quad . \quad . \quad \hat{V}_{m+1}(n-2) \quad \hat{V}_{m+1}(n-1) \quad \hat{V}_{m+1}(n)]$$

We now write n Equations

$$\hat{V}_{m+1}(j) = \frac{\overline{V}_{m+1}(j)}{\left\{\sum_{j=1}^{n} \{\overline{V}_{m+1}(j)\}^2\right\}^{1/2}}$$

for $j = 1 \; to \; n$

and solve for $\overline{V}_{m+1}(j)$ for $j = 1 \; to \; n$.

$$\overline{V}_{m+1} = \left\{ \sum_{j=1}^{n} \{\overline{V}_{m+1}(j)\}^2 \right\}^{1/2}$$

Finally, we have

$$\overline{V}_{m+1} = |\overline{V}_{m+1}| \hat{V}_{m+1}.$$

***Case 2*:**

We re-write $\hat{V}_u(j)$ as $\hat{V}_{u_j}(j)$ just to clarify that for every j , u may be different.

$$\hat{V}_m(j) < \hat{V}_{u_j}(j)$$

We define

$$\hat{V}_{m+1}(j) = \{\hat{V}_m(j)\} \left[\frac{\hat{V}_{u_j}(j)}{\hat{V}_m(j)} \{T_{u \to (u+1)}(j)\} \right]$$

We now have

$$\hat{V}_{m+1} = [\hat{V}_{m+1}(1) \quad \hat{V}_{m+1}(2) \quad \hat{V}_{m+1}(3) \quad . \quad . \quad . \quad \hat{V}_{m+1}(n-2) \quad \hat{V}_{m+1}(n-1) \quad \hat{V}_{m+1}(n)]$$

We now write n Equations

$$\hat{V}_{m+1}(j) = \frac{\overline{V}_{m+1}(j)}{\left\{ \sum_{j=1}^{n} \{\overline{V}_{m+1}(j)\}^2 \right\}^{1/2}}$$

for $j = 1 \, to \, n$

and solve for $\overline{V}_{m+1}(j)$ for $j = 1 \, to \, n$.

$$\overline{V}_{m+1} = \left\{ \sum_{j=1}^{n} \{\overline{V}_{m+1}(j)\}^2 \right\}^{1/2}$$

Finally, we have

$$\overline{V}_{m+1} = |\overline{V}_{m+1}| \hat{V}_{m+1}.$$

Conclusion

This Scheme can be used to predict the *One Step Evolution* of any *Dynamic State System* with Large Number of Parameters.

Moral

Clear Waters Run Deep.

References

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Dedication

*All of the aforementioned Research Works, inclusive of this One are **Dedicated to Lord Shiva**.*