A Locally Linear Transformations And Linear Interpolations Based Forecasting Model For Dynamic State System With Large Number Of Parameters

By

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1 **Abstract**

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

2 **Theory**

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

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

3 That is,

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

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

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

4 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 $i = m$.

5 The *Normalization* is given by

$$\hat{V}_i = \frac{\overline{V_i}}{\left\{\sum_{j=1}^{n} [V_{ij}]^2\right\}^{1/2}} \text{ That is, } \hat{V}_i = \frac{\sum_{j=1}^{n} \{[V_{ij}]\hat{e}_j\}}{\left\{\sum_{j=1}^{n} [V_{ij}]^2\right\}^{1/2}}$$

6 We now define $T_{s\to(s+1)}(j) = \dfrac{\hat{V}_{(s+1)j}}{\hat{V}_{sj}}$

7 If $\hat{V}_{mj}$ is closest to some $\hat{V}_{(u_j)j}$ when we run u_j through $1 \le u_j \le m$

8 ***Case 1***:

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

9 We define

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

10 We now have

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

11 We now write n Equations

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

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

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

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

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

13 ***Case 2***:

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

14 We define

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

15 We now have

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

16 We now write n Equations

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

for $j = 1 \ to \ n$

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

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

Finally, we have

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

18 **Conclusion**

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