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THE RANDOM DATA-REUSING GMCC ADAPTIVE FILTERING ALGORITHM FOR SYSTEM IDENTIFICATION UNDER IMPULSIVE NOISE ENVIRONMENTS

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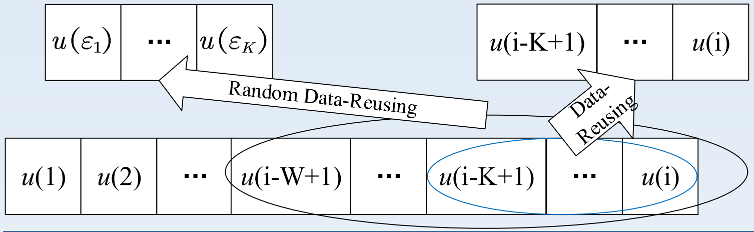
Abstract

The generalized maximum correntropy criterion (GMCC) has been widely applied for robust adaptive filtering (AF) algorithm. The gradient-based GMCC (GB-GMCC) algorithm realizes good filtering performance for system identify-cation under impulsive noise environments. However, the highly colored input signal can damage the convergence rate of GB-GMCC. Therefore, based on the data-reusing method, we propose a robust AF algorithm, called as data-reusing GMCC (DR-GMCC) algorithm, which uses the information of the latest K input data to remedy the convergence limitation of GB-GMCC. In addition, to enhance the filtering performance of DR-GMCC, we use a random strategy to select the past K input data leading to a new algorithm, named as random DR-GMCC (RDR-GMCC). Furthermore, for RDR-GMCC, we also analyze the mean square convergence and computational complexity. Compared with existing algorithms, simulation results verify that RDR-GMCC achieves better filtering accuracy and faster convergence rate.

Methods



Conclusion

For RDR-GMCC, we have analyzed the computational complexity and mean-square convergence condition. Simulation results for system identification validate that, compared with existing algorithms, RDR-GMCC algorithm can achieve better filtering accuracy and faster convergence rate. In addition, we have conducted some experiments studying the influence of crucial parameters, i.e., K and W, on the filtering performance of RDR-GMCC. And, we have found that, when W>>K, some large K value can obviously enhance the filtering performance of RDR-GMCC.

The proposed algorithm

Algorithm 1: Pseudocode of RDR-GMCC

Initialization: $\tau > 0,\ s > 0,\ W > K \geq 1,\ \eta > 0$ and $\boldsymbol{w}(0) = \boldsymbol{0}$

Computation:

While $\{\boldsymbol{u}(i), d(i)\}$ available **do**

if $i \leq K$

1) $\varepsilon_n = i \rightarrow \boldsymbol{u}(\varepsilon_n) = \boldsymbol{u}(i)$

elseif $K < i \leq W$

2) $\varepsilon_n \in [1, i] \rightarrow \boldsymbol{u}(\varepsilon_n)$

else $i > W$

3) $\varepsilon_n \in [i - W + 1, i] \rightarrow \boldsymbol{u}(\varepsilon_n)$

end if

4) $y(\varepsilon_n) = \boldsymbol{u}(\varepsilon_n)^T \boldsymbol{w}_i,$

5) $e(\varepsilon_n) = d(\varepsilon_n) - y(\varepsilon_n)$

6) $f(e(\varepsilon_n)) = \exp(-\tau|e(\varepsilon_n)|^s)|e(\varepsilon_n)|^{s-2}e(\varepsilon_n)$

7) $\boldsymbol{w}(i+1) = \boldsymbol{w}(i) + \frac{\eta}{K}\sum_{\varepsilon_n} f(e(\varepsilon_n))\boldsymbol{u}(\varepsilon_n)$

End while

Apply Data-Reusing To GMCC: key equations

$$J(\boldsymbol{w}) = \frac{1}{K}\sum_{n=i-K+1}^{i} \exp(-\tau|e(n)|^s)$$

$$\boldsymbol{w}(i+1) = \boldsymbol{w}(i) + \frac{\eta}{K}\sum_{n=i-K+1}^{i} f(e(n))\boldsymbol{u}(n)$$

In this case,
GMCC can obtain more error information

Window memory is applied: key equations

$$J(\boldsymbol{w}) = \frac{1}{K}\sum_{\varepsilon_n \in Id} \exp(-\tau|e(\varepsilon_n)|^s)$$

$$\boldsymbol{w}(i+1) = \boldsymbol{w}(i) + \frac{\eta}{K}\sum_{\varepsilon_n \in Id} f(e(\varepsilon_n))\boldsymbol{u}(\varepsilon_n)$$

In this case,
the proposed algorithm is the RDR-GMCC

Simulation Results

Object:
System identification

Model:

$$d(i) = \boldsymbol{u}(i)^T\boldsymbol{h}^o + v(i)$$

Parameters:

$v(i)$ is $\alpha - \mathrm{SD}$ with

$$\begin{cases} \boldsymbol{p}_\alpha^T = [1.5\ \ 0\ \ 0\ \ 0.3] \\ \boldsymbol{p}_\alpha^T = [1.5\ \ 0\ \ 0\ \ 0.1] \\ \boldsymbol{p}_\alpha^T = [1.0\ \ 0\ \ 0\ \ 1.0] \end{cases}$$

$$\boldsymbol{u}(i) = \begin{bmatrix} x(i) \\ x(i-1) \\ \vdots \\ x(i-31) \end{bmatrix}$$

$$\boldsymbol{h}^o = [h_1^o, h_2^o, ..., h_{32}^o]$$