

How to Handle negative “delta_COM” in the COM Matlab Code

COM Commit Request Number 4p8_2

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Introduction

- During investigations related to COM Commit Request Numbers 4p8_1, a case was observed that would result in negative calculated delta_com due to excessive noise caused by double counting of the RxFFE noise amplification
- The negative value is overridden to 0 when delta_COM is reported
- However, the code proceeds with the negative value and consequently reduces COM, which could even become negative:

Before Change 4p8_1	After Change 4p8_1
<pre>CDF: [1x29133 double] PDF: [1x1 struct] DER_MLSE_trunc: 1.7390e-04 Q_budget_adj: 0 COM_from_matlab: 0.5246 DER_MLSE: 1.7390e-04 DER_DFE: 3.9645e-05 COM: -0.3223 delta_com: 0 g_an: 8.1800</pre>	<pre>CDF: [1x26709 double] PDF: [1x1 struct] DER_MLSE_trunc: 8.2701e-06 Q_budget_adj: 0 COM_from_matlab: 0.5246 DER_MLSE: 8.2701e-06 DER_DFE: 3.9645e-05 COM: 1.2795 delta_com: 0.7549 g_an: 8.1800</pre>

- Hopefully commit Request Number 4p8_1 fixes this issue (as it did for this case):
- Nevertheless, the question is: Should the overridden delta_COM be used thereafter?

The Good and the Bad

- 😊 “the Good” : Using the overridden `delta_COM` of 0 to proceed with overall COM calculation, ensures that in cases where MLSE is deemed to be destructive it won't be used
- 😞 “the Bad” : However, such cases are not expected to happen and if they do, it is likely because of the synthesized approach taken to mimic the implementation penalty, and using the overridden value masks the visibility of these unexpected, but potential, cases
- The override was a precaution to ignore MLSE if signal quality was poor for clock recovery
- With the lack of a more realistic approach to calculating the implementation penalty (beyond the scope of COM ad hoc), the following is suggested:
 - ❖ Apply “the Good” and
 - ❖ Report the calculated negative `delta_COM` to keep the visibility of “the Bad”
 - ❖ Apply the override to `delta_COM_notrunc` as well

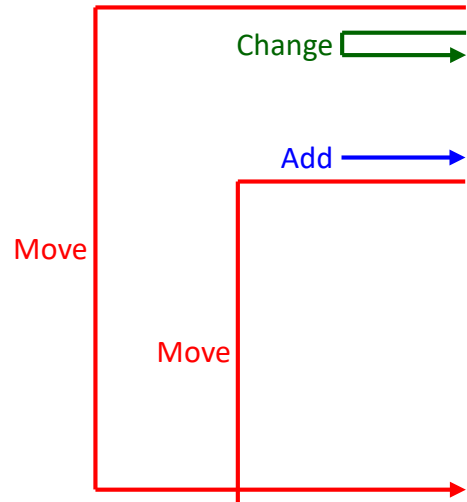
Change from:

```

2217 %% shakiba_3dj_01_2407
2218 % delta_com=20*log10(1/A_s *-CDF_inv_ev ( DER_MLSE ,p_an,P_an ) )- param.Q ;% shakiba_3dj_01_2405
2219 - delta_com=20*log10(1/A_s *-CDF_inv_ev ( DER_MLSE_trunc,p_an,P_an ) )- Q_budget_adj ;% shakiba_3dj_01_2405
2220 - DER_MLSE_trunc= CDF_ev(A_s*10^(delta_com/20),PDF,CDF);% 4p7 re-evaluates with truncation (delta_com includes truncation)
2221 - delta_com_notrunc= 20*log10(1/A_s *-CDF_inv_ev(DER_MLSE,p_an,P_an) ) - Q_budget_adj; % 4p7 calculates COM without truncation
2222 - DER_MLSE=CDF_ev(A_s*10^(delta_com_notrunc/20),PDF,CDF);% 4p7 re-evaluated DER without truncation
2223 %% shakiba_3dj_01_2407
2224 % delta_com=20*log10(1/A_s *-CDF_inv_ev ( 2/3*DER_MLSE,p_an,CDF ) )- Q ;% (178A-36)
2225 - new_com=COM_from_matlab+delta_com;
2226 - if(delta_com<0)
2227 -     delta_com=0;
2228 -     warning('MLSE truncation failed. Try increasing trunc')
2229 -     try
2230 -         hx=msgbox('MLSE truncation failed. Try increasing N_tc','warning','warn');
2231 -         set(hx,'Color',[1 0 1]);
2232 -         movegui(hx,[randn randn]*100)
2233 -         set(hx,'Tag','COM') %
2234 -     catch
2235 -     end
2236 - end
2237 - else
2238 -     warning('MLSE not applied because the DER is less than that required for the CDR to lock')
2239 -     DER_MLSE=NaN;
2240 -     new_com=COM_from_matlab;
2241 -     delta_com=0;
2242 -     Q=0;
2243 -     Q_budget_adj=0;
2244 -     DER_MLSE_trunc=NaN;
2245 -     %% shakiba_3dj_01_2407
2246 - end
2247 -
2248 %%
2249 - [PDF1, CDF1, ~] = scaleCDF( PDF,-delta_com,DER0, A_s ); % create new pdf/cdf estimate for display only
2250 - MLSE_results.CDF=CDF1;
2251 - MLSE_results.PDF=PDF1;
2252 - MLSE_results.DER_MLSE_trunc = DER_MLSE_trunc;% shakiba_3dj_01_2407 (to add MLSE sequence truncation penalty)
2253 - MLSE_results.Q_budget_adj=Q_budget_adj; % healey_3dj_01a_2407
2254 - MLSE_results.COM_from_matlab=COM_from_matlab;
2255 - MLSE_results.DER_MLSE=DER_MLSE;
2256 - MLSE_results.DER_DFE=DER_DFE;
2257 - MLSE_results.COM=new_com;
2258 - MLSE_results.delta_com=delta_com;
2259 - MLSE_results.g_an=g_an;

```

Change to:



```

2217 %% shakiba_3dj_01_2407
2218 % delta_com=20*log10(1/A_s *-CDF_inv_ev ( DER_MLSE      ,p_an,P_an ) )- param.Q ;% shakiba_3dj_01_2405
2219 - delta_com=20*log10(1/A_s *-CDF_inv_ev ( DER_MLSE_trunc,p_an,P_an ) )- Q_budget_adj ;% shakiba_3dj_01_2405
2220 %   DER_MLSE_trunc= CDF_ev(A_s*10^(delta_com/20),PDF,CDF);% 4p7 re-evaluates with truncation (delta_com includes truncation)
2221 %   delta_com_notrunc= 20*log10(1/A_s *-CDF_inv_ev(DER_MLSE,p_an,P_an) ) - Q_budget_adj; % 4p7 calculates COM without truncation
2222 - delta_com_notrunc= max(0, 20*log10(1/A_s *-CDF_inv_ev(DER_MLSE,p_an,P_an) ) - Q_budget_adj); % 4p7 calculates COM without truncation
2223 - DER_MLSE=CDF_ev(A_s*10^(delta_com_notrunc/20),PDF,CDF);% 4p7 re-evaluated DER without truncation
2224 %% shakiba_3dj_01_2407
2225 % delta_com=20*log10(1/A_s *-CDF_inv_ev ( 2/3*DER_MLSE,p_an,CDF ) )- Q ;% (178A-36)
2226 - delta_com_calc = delta_com;
2227 %   new_com=COM_from_matlab+delta_com;
2228 - if(delta_com<0)
2229 -     delta_com=0;
2230 -     warning('MLSE truncation failed. Try increasing trunc')
2231 -     try
2232 -         hx=msgbox('MLSE truncation failed. Try increasing N_tc','warning','warn');
2233 -         set(hx,'Color',[1 0 1]);
2234 -         movegui(hx,[randn randn]*100)
2235 -         set(hx,'Tag','COM') %
2236 -     catch
2237 -     end
2238 - end
2239 - DER_MLSE_trunc= CDF_ev(A_s*10^(delta_com/20),PDF,CDF);% 4p7 re-evaluates with truncation (delta_com includes truncation)
2240 - new_com=COM_from_matlab+delta_com;
2241 else
2242 - warning('MLSE not applied because the DER is less than that required for the CDR to lock')
2243 - DER_MLSE=NaN;
2244 - new_com=COM_from_matlab;
2245 - delta_com=0;
2246 - delta_com_calc = delta_com;
2247 - Q=0;
2248 - Q_budget_adj=0;
2249 - DER_MLSE_trunc=NaN;
2250 %% shakiba_3dj_01_2407
2251 end
2252 %%
2253 [PDF1, CDF1, ~] = scaleCDF( PDF,-delta_com,DER0, A_s ); % create new pdf/cdf estimate for display only
2254 MLSE_results.CDF=CDF1;
2255 MLSE_results.PDF=PDF1;
2256 MLSE_results.DER_MLSE_trunc = DER_MLSE_trunc;% shakiba_3dj_01_2407 (to add MLSE sequence truncation penalty)
2257 MLSE_results.Q_budget_adj=Q_budget_adj; % healey_3dj_01a_2407
2258 MLSE_results.COM_from_matlab=COM_from_matlab;
2259 MLSE_results.DER_MLSE=DER_MLSE;
2260 MLSE_results.DER_DFE=DER_DFE;
2261 MLSE_results.COM=new_com;
2262 MLSE_results.delta_com=delta_com;
2263 MLSE_results.delta_com_calc = delta_com_calc;
2264 MLSE_results.g_an=g_an;
2265

```

Apply overridden
delta_COM thereafter

Report calculated
delta_COM for visibility

Override negative
delta_COM_notrunc

Thank You 😊

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