MEDIATEK

JVET-O0280
CE4-related: SIMD implementation for weighted sample prediction process of triangle prediction mode

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Overall Summary

- Single instruction multiple data (SIMD) implementation for the weighted sample prediction process of triangle prediction mode (TPM)
  - Encoding time is reduced by 2% for RA and 3% for LB without BD-rate changes

	Over VTM-5.0 (%)		Y	U	V	EncT	DecT
1	SIMD implementation for the weighted sample prediction process	RA	0.00	0.00	0.00	98%	98%
		LB	0.00	0.00	0.00	97%	100%

Introduction

- Weighted sample prediction process is one of the time-consuming functions
  - Profiling results of using VTM5.0 to encode BQSquare sequence at QP37 for 1 second

Function Name	Total CPU [unit, %]	Self CPU [unit, %] ▾	Module
EncoderApp.exe (PID: 15848)	489821 (100.00%)	0 (0.00%)	EncoderApp.exe
AlfCovariance::gnsCholeskyDec	55186 (11.27%)	46835 (9.56%)	EncoderApp.exe
AlfCovariance::gnsBacksubstitution	25614 (5.23%)	25594 (5.23%)	EncoderApp.exe
RdCost::getWeightedMSE	24205 (4.94%)	19983 (4.08%)	EncoderApp.exe
EncAdaptiveLoopFilter::getBlkStats	17541 (3.58%)	16112 (3.29%)	EncoderApp.exe
InterPrediction::xWeightedTriangleBlk	15049 (3.07%)	15022 (3.07%)	EncoderApp.exe
simdInterpolateHorM4<4,8,0>	15172 (3.10%)	14964 (3.05%)	EncoderApp.exe
AlfCovariance::gnsTransposeBacksubstitution	11552 (2.36%)	11541 (2.36%)	EncoderApp.exe
simdInterpolateVerM4<4,8,1>	10953 (2.24%)	10761 (2.20%)	EncoderApp.exe

Proposed

- Apply SIMD implementation to the weighted sample prediction process to reduce the encoding time
- No BD-rate changes

Profiling results of using VTM5.0 with proposed SIMD implementation to encode BQSquare sequence at QP37 for 1 second

Function Name	Total CPU [unit, %]	Self CPU [unit, %] ▾	Module
EncoderApp.exe (PID: 3092)	493456 (100.00%)	0 (0.00%)	EncoderApp.exe
AlfCovariance::gnsCholeskyDec	56520 (11.45%)	48563 (9.84%)	EncoderApp.exe
AlfCovariance::gnsBacksubstitution	26161 (5.30%)	26149 (5.30%)	EncoderApp.exe
RdCost::getWeightedMSE	24601 (4.99%)	20140 (4.08%)	EncoderApp.exe
EncAdaptiveLoopFilter::getBlkStats	18255 (3.70%)	16733 (3.39%)	EncoderApp.exe
simdInterpolateHorM4<4,8,0>	15721 (3.19%)	15493 (3.14%)	EncoderApp.exe
AlfCovariance::gnsTransposeBacksubstitution	11839 (2.40%)	11834 (2.40%)	EncoderApp.exe
simdInterpolateVerM4<4,8,1>	11335 (2.30%)	11164 (2.26%)	EncoderApp.exe
AreaBuf<short>::rspSignal	9116 (1.85%)	9111 (1.85%)	EncoderApp.exe
InterPrediction::xPredAffineBlk	52054 (10.55%)	8581 (1.74%)	EncoderApp.exe
simdInterpolateHorM8_AVX2<4,8,0>	7148 (1.45%)	7130 (1.44%)	EncoderApp.exe
__security_check_cookie	6969 (1.41%)	6966 (1.41%)	EncoderApp.exe
DQIntern::State::checkRdCosts	6679 (1.35%)	6677 (1.35%)	EncoderApp.exe
AlfCovariance::calcErrorForCoeffs	6658 (1.35%)	6658 (1.35%)	EncoderApp.exe
AlfCovariance::optimizeFilter	103995 (21.07%)	6417 (1.30%)	EncoderApp.exe
simdInterpolateVerM8_AVX2<4,8,0>	6156 (1.25%)	6137 (1.24%)	EncoderApp.exe
simdEqualCoeffComputer<4>	6056 (1.23%)	6050 (1.23%)	EncoderApp.exe
IntraPrediction::xPredIntraAng	4738 (0.96%)	4598 (0.93%)	EncoderApp.exe
InterPrediction::xPredInterBlk	35792 (7.25%)	4460 (0.90%)	EncoderApp.exe
DQIntern::State::updateState<5>	4171 (0.85%)	4170 (0.85%)	EncoderApp.exe
InterpolationFilter::filterCopy<1,0>	4104 (0.83%)	4103 (0.83%)	EncoderApp.exe
xCalcHAD8x16_AVX2<short,short>	4079 (0.83%)	3926 (0.80%)	EncoderApp.exe
DQIntern::DepQuant::xDecide	11959 (2.42%)	3806 (0.77%)	EncoderApp.exe
xWeightedTriangleBlk_SSE<4>	3778 (0.77%)	3776 (0.77%)	EncoderApp.exe
simdInterpolateVerM8_AVX2<4,8,1>	3780 (0.77%)	3767 (0.76%)	EncoderApp.exe
xCalcHAD16x16_AVX2<short,short>	3539 (0.72%)	3508 (0.71%)	EncoderApp.exe
DQIntern::State::updateState<4>	3471 (0.70%)	3471 (0.70%)	EncoderApp.exe

Simulation results

- SIMD implementation for the weighted sample prediction process
  - 2% and 3% EncT reduction for RA and LB
  - TPM accounts for 8% and 13% EncT for RA and LB

	Random access Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1	0.00%	0.00%	0.00%	98%	98%
Class A2	0.00%	0.00%	0.00%	98%	98%
Class B	0.00%	0.00%	0.00%	98%	97%
Class C	0.00%	0.00%	0.00%	97%	97%
Class E					
Overall	0.00%	0.00%	0.00%	98%	98%
Class D	0.00%	0.00%	0.00%	97%	100%
Class F	0.00%	0.00%	0.00%	99%	97%

	Low delay B Main10				
	Over VTM-5.0				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	0.00%	0.00%	0.00%	97%	100%
Class C	0.00%	0.00%	0.00%	97%	101%
Class E	0.00%	0.00%	0.00%	96%	98%
Overall	0.00%	0.00%	0.00%	97%	100%
Class D	0.00%	0.00%	0.00%	95%	98%
Class F	0.00%	0.00%	0.00%	97%	98%

Conclusions

- Proposed to apply SIMD implementation for weighted sample prediction process
- No BD-rate changes
- Thanks Sharp for cross-checking