

# **Unified Search range for FRUC (JVET-H0058)**

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# Summary

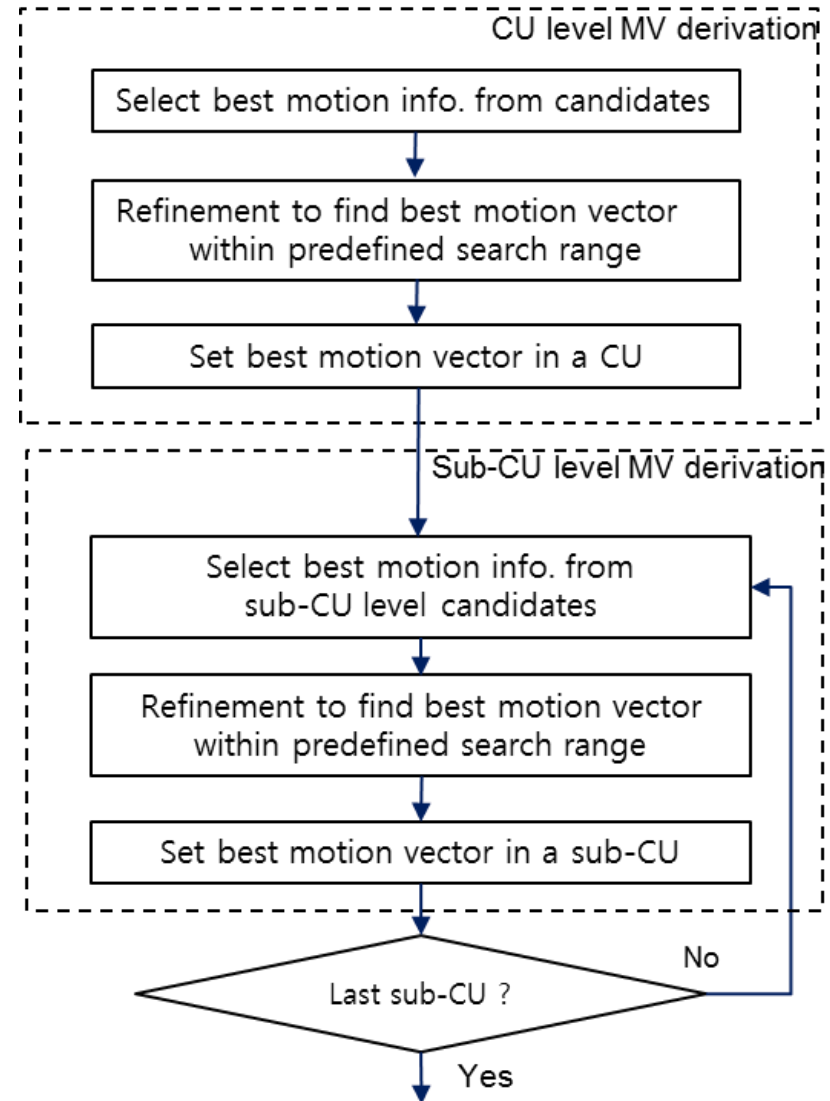
- Propose FRUC motion estimation process based on a unified search range for FRUC
- One unified search range
  - Applying one search range for estimating motion information of CU and sub-CU for FRUC
    - Construct candidates for derive initial MV of sub-CU within the proposed unified search range which is already patched for CU level motion estimation.
    - Estimate best MV of sub-CU based on the proposed search range.
- Experimental results

	Over HM-16.6-JEM-7.0				
	Y	U	V	EncT	DecT
Random Access	0.0%	0.1%	0.0%	100%	99%
Low Delay B	0.0%	0.0%	0.1%	99%	99%
Low Delay P	0.0%	-0.0%	-0.2%	102%	103%

- Crosscheck
  - JVET-H0077 (Samsung)

# FRUC in current JEM-7.0

- Motion estimation process for CU and sub-CU
  - Step1: Select best candidate from predefined candidates
  - Step2: Refine motion vector found in Step1. Here, the best motion vector is searched (or motion vector is refined) within the predefined search range.
  - Step3: Store the best motion information.



# FRUC in current JEM-7.0

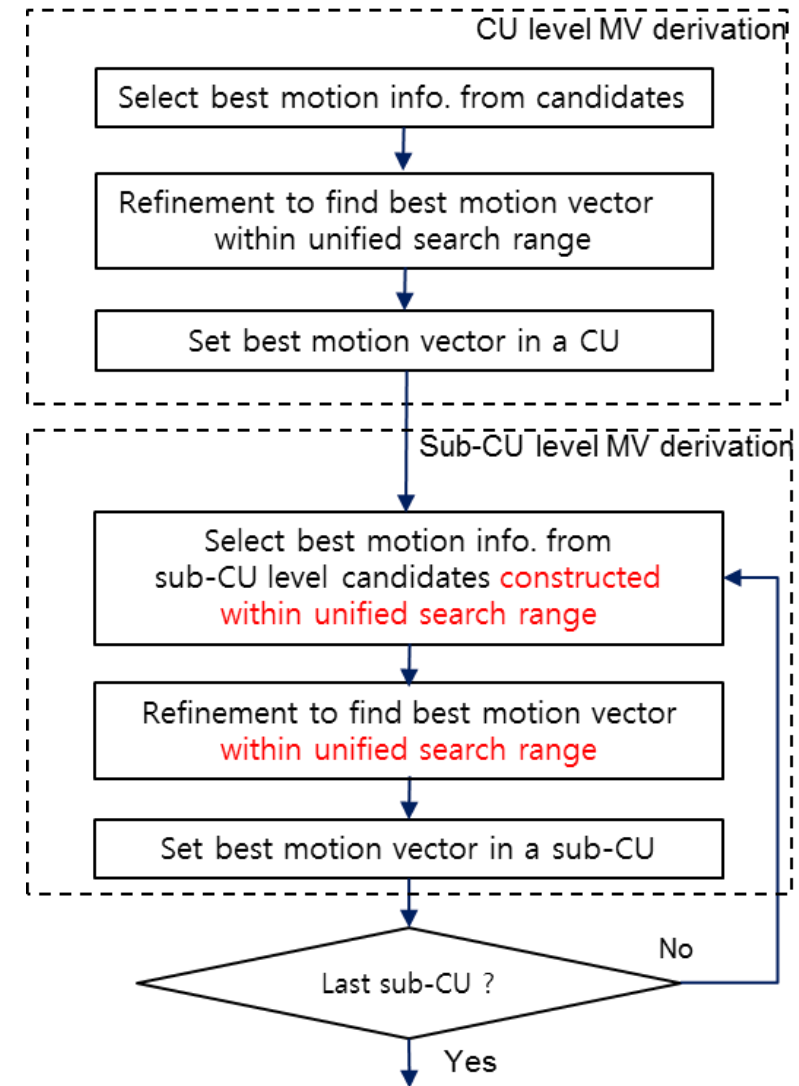
- FRUC in current JEM-7.0
  - Patching reference picture for motion estimation of a CU and each sub-CU.
  - A CU could be split into 64 sub-CU.
  - For motion estimation, 65 times patch would be needed for search range.
  - The conventional scheme would be bottleneck in terms of memory bandwidth.

Table. the number of sub-CUs based on CU sizes

CU size (WxH)	Sub-CU size	#of sub-CU
256x256	32x32	64
128x64	16x16	32
64x64	8x8	64
64x32	8x8	32
64x8	4x4	32
32x32	4x4	64
32x8	4x4	32

# Proposed method

- FRUC motion estimation with unified search range
  - Search range are patched just one time for CU level
  - Candidates which have motion information inside the search range only are constructed for sub-CU.
  - Motion estimation process are applied in the already patched search range for sub-CU



# Experimental results

	Over HM-16.6-JEM-7.0 (Random access main10)				
	Y	U	V	EncT	DecT
Class A1	0.1%	0.0%	0.0%	100%	99%
Class A2	0.1%	0.1%	0.1%	99%	99%
Class B	0.0%	0.0%	0.0%	101%	100%
Class C	0.0%	0.1%	0.1%	101%	100%
Class D	0.0%	0.2%	-0.1%	99%	98%
Overall (Ref)	0.0%	0.1%	0.0%	100%	99%
Class F (optional)	0.0%	0.1%	0.2%	99%	103%
	Over HM-16.6-JEM-7.0 (Low delay B main10)				
	Y	U	V	EncT	DecT
Class B	0.0%	0.0%	-0.2%	99%	94%
Class C	0.0%	0.1%	0.4%	101%	98%
Class D	0.1%	-0.4%	-0.6%	103%	97%
Class E	0.0%	0.5%	1.1%	98%	97%
Overall (Ref)	0.0%	0.0%	0.1%	100%	96%
Class F (optional)	0.1%	0.6%	0.2%	102%	101%
	Over HM-16.6-JEM-7.0 (Low delay P main10)				
	Y	U	V	EncT	DecT
Class B	0.0%	-0.1%	0.0%	101%	102%
Class C	0.0%	-0.1%	-0.4%	102%	100%
Class D	0.0%	-0.3%	0.0%	103%	103%
Class E	0.0%	0.3%	-0.4%	100%	107%
Overall (Ref)	0.0%	-0.1%	-0.2%	102%	103%
Class F (optional)	0.0%	0.1%	-0.1%	102%	107%

# Conclusion

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- Recommendation
  - It is recommended to use the proposed unified search range for FRUC motion estimation process in next JEM.