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# Abstract

本提案提出一种非直线划分方法，即引入贝塞尔曲线描述块划分边界，用于块的运动补偿。在VTM 19.2 平台上，RA配置下获得了xxxx的BD-rate增益，LD-B配置下获得了xxxx的BD-rate增益，并取得主观质量的提升

# Introduction

为了分别提高前景运动物体和背景图像的预测精度，在VVC 后期的研制过程中R. Liao 提出了三角形划分模式(triangular prediction unit mode, TPM)，简单地包含左上到右下、右上到左下2 种对称的划分模式。S. Esenlik提出了几何划分(geometric partitioning, GEO)。该划分方式附加了角度参数α 以11.25°为增量单位，附加了偏移参数ψ 刻画5 个不同的距离值，再结合边界像素的融合处理，能同时提高运动物体和静止背景内容的编码性能。如但当图像物体边界为曲线型时，GPM需要引入更多的子块来表示物体边界。因此引入贝塞尔曲线描述的块划分边界方式。

# 提案内容

## 贝塞尔曲线简介

贝塞尔曲线依靠形式简洁的伯恩斯坦基底多项式表达，在平面笛卡尔坐标系下，给定P0 和P1 两个点，线性贝塞尔曲线是一条直线；给定P0、P1、P2 三个点，二次方贝塞尔曲线是一条平滑的单拱曲线；给定P0、P1、P2、P3 四个点，三次方贝塞尔曲线可以是一条凹凸双拱曲线。本提案中所用的2次和3次贝塞尔曲线的方程如下式：

B(t) = (1-t)2P0+2t(1-t)P1+t2P2 ,t∈[0,1]

B(t) = (1-t)3P0+3t(1-t)2P1+3t2(1-t)P2+t3P3 , t∈[0,1]

## 贝塞尔曲线控制点导出

编解码端使用一维梯度算子计算左侧和上侧相邻行列像素，找到梯度幅值最大点为阶跃点，以该两点为贝塞尔曲线的起点s和终点t。如图 1所示



**Figure 1 – gradient method for Bezier control points finding**

之后，找到st两点的中垂线，找到中垂线与上方或左方边界的交点，该交点为贝塞尔曲线内部点，对应disOffset = 0模式，以CU块对角线长的1/32为步长，向块右下侧扩展，直到控制点位置超过CU范围，如图2所示。



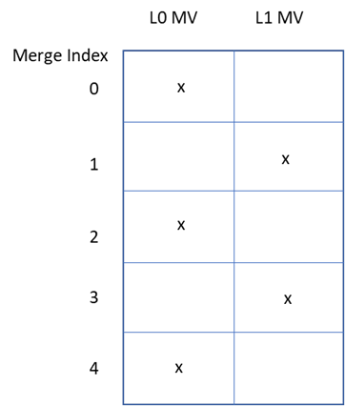
**Figure 2 – generation of disOffset in Bezier partition mode**

根据st和disOffset可以确定中心控制点所在位置，进而完全确定贝塞尔曲线。使用贝塞尔曲线将CU分为两部分。每个部分单独进行运动补偿。

## 单项预测候选列表构造

与GPM相同，为简化运动信息编码，贝塞尔曲线划分模式两个子区域都只使用单向预测，并以Merge模式编码。因此，两个子区域的运动矢量由模式专用的单向MVP候选列表。列表索引merge\_gpm\_idx0 （区域0运动矢量）和merge\_gpm\_idx1 （区域l 运动矢量）获得。

当GPM\_MVP列表中候选索引为偶数时，其候选MV选择MergeMVP列表中对应索引的前向MV0 （参考列表L0) ，如果MV0不存在，则选择后向MV1 （参考列表L1)。当GPM\_MVP列表中候选索引为奇数时，其候选MV选择MergeMVP列表中对应索引的后向MV1(参考列表L1)，如果MV1不存在，则选择前向MV0(参考列表L0)。如图3。



**Figure 3 – Uni-prediction MV selection for Bezier partitioning mode**

## 运动信息存储

以4x4 子块为单位计算和记录其运动矢量信息，因贝塞尔曲线划分后，分区边界较复杂，因此采用简单下采样方式，将分区信息以邻近采样方式对应到4x4运动信息块上，进行运动信息存储。

## 语法元素

符合以下条件的CU才可使用贝塞尔曲线划分模式

1. Sps层参数sps\_bez\_enabled\_flag==1.
2. CU属于B Slice.
3. CU亮度分量宽和高均大于等于16且均小于等于128，且宽高比大于1/8且小于8.

当CU采用贝塞尔曲线划分模式时

General\_merge\_flag == 1

Merge\_subblock\_flag ==0

regular\_merge\_flag ==0

ciip\_flag==0

bez\_flag==1，（当bez\_flag==0时采用GPM）

### SPS层语法元素

sps\_bez\_enabled\_flag: 标识当前序列是否运行使用贝塞尔曲线划分模式。

sps\_max\_num\_merge\_cand\_minus\_max\_num\_bez\_cand: 标识MVP列表最大候选项数量

### CU层

merge\_bez\_dis\_idx: 标识当前贝塞尔曲线划分模式的disOffset

merge\_bez\_idx0和merge\_bez\_idx1：分别标识当前CU在贝塞尔曲线划分模式下的量分区的候选索引

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