It is important to note that, in the proposed JRVIR approach, as not all the macroblocks need to have redundant motion vector, a new flag is applied in each macroblock to indicate whether there is redundant motion vector. For these macroblocks with redundant motion vector, there will be no transformed coefficients to be encapsulated in the redundant macroblocks. Therefore, the proposed JRVIR would not be standard compatible, and some small modifications are required for both the encoder and decoder.

In general, Intra coding is more expensive in terms of rate requirement with respect to redundant motion vector, therefore for the macroblocks with smooth texture and/or macroblocks with slow and translational movements, providing redundant motion vector would lead to better resource utilization, i.e., bitrate, with respect to the Intra coding. Whether to encode one macroblock with intra mode, inter mode with redundant motion vector or without motion vector is determined by our JRVIR rate-distortion optimization process.

A. The JRVIR Rate-distortion Optimization

As in other encoding approaches, in the JRVIR rate-distortion optimization process, the encoder selects the coding option $O^*$ for the current encoding macroblock, so that the Lagrangian cost functional is minimized.

$$O^* = \arg \min_{o \in \Omega_{JRVIR}} (D_{MB}(o) + \lambda_{mode} R_{MB}(o))$$

(8)