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U.S. Patent 8,494,058

U.S. Patent 8,494,058 ("*Communication Advances*" or the "patent-at-issue") was filed on September 9, 2012. According to the paragraph in the specification entitled "Cross-Reference to Related Applications," the patent-at-issue is a continuation-in-part of co-pending U.S. Pat. App. No. 2012/143854, filed on Jun. 23, 2008. Claim 11 of the patent-at-issue is generally directed to a video/image processing method of retrieving multiple images from a storage module and generating motion vectors based on these images. Subsequently, a variety of video/image processing operations are executed, each corresponding to the motion vectors. These processing operations include, among others, a first operation focusing on frame rate conversion guided by the received motion vectors, and a second operation involving the encoding of images to produce a compressed bit-stream, again based on the received motion vectors.

The primary reference, the U.S. Patent 8,358,373 ("*Sharp*"), was filed on May 18, 2007 and claims priority on December 22, 2006 based on Foreign Application Priority Data. The patent is directed to an image displaying device and method and an image processing device and method having a function of converting a frame rate or field rate, which include preventing the image quality deterioration of a moving image likely to include a plurality of the same consecutive images due to a motion-compensated rate conversion processing.

A secondary reference, U.S. Patent 9,258,519 ("*Qualcomm*"), was filed on September 25, 2006, and claims an earliest priority on September 27, 2005. The patent is directed to an Encoder Assisted Frame Rate Up Conversion (EA-FRUC) system that utilizes various motion models, such as affine models, in addition to video coding and pre-processing operations at the video encoder to exploit the FRUC processing that will occur in the decoder in order to improve the modeling of moving objects, compression efficiency and reconstructed video quality. Furthermore, objects are identified in a way that reduces the amount of information necessary for encoding to render the objects on the decoder device.

A secondary reference, U.S. Pat. App. 2009/0161011 ("*Intel*"), was filed on December 21, 2007, and claims priority on the same date. The patent application is directed to a frame rate conversion (FRC) method using two or more frames to detect and determine their relative motion. An interpolated frame between the two frames may be created using a derived motion, a time stamp given, and consecutive frame data. Global estimation of each frame is utilized, resulting in reduced occlusion, reduced interpolation artifacts, selective elimination of judder, graceful degradation, and low complexity.

A sample claim chart comparing claim 11 of *Communication Advances* to *Sharp*, *Qualcomm*, and *Intel* is provided below.

US8494058 ("*Communication Advances*")	**A. US8358373** (*"Sharp"*) **B. US9258519** (*"Qualcomm"*) **C. US20090161011** (*"Intel"*)
11.pre. A **video/image processing method**, comprising:	**A. US8358373** "FIG. 6 is a block diagram of an example of a schematic configuration of an FRC drive display circuit in the present invention and, in FIG. 6, **the FRC drive display circuit includes an FRC portion** 100 **that converts the number of frames of the input image signal by interpolating the image signals to which the motion compensation processing has been given between frames of the input image signal**. . . ." *Sharp* at col. 13:20-26 "The present invention relates to an image displaying device and method and an **image processing** device and **method** ..." *Sharp* at col. 1:7-8 **B. US9258519** "FIG. 1A is an illustration of an example of a communication system implementing an **encoder assisted frame rate up conversion (EA-FRUC) system using various motion models** in accordance with one aspect for delivery of streaming video. System 100 includes encoder device 105 and decoder device 110." *Qualcomm* at col. 7:6-11 "In one aspect, **a method of processing multimedia data** is disclosed." *Qualcomm* at col. 3:48-49 **C. US20090161011** "FIG. 3 is an upper-level diagram showing the flow of **a frame rate conversion (FRC) method** 100, according to some embodiments. The FRC method 100 takes as input a current frame (C) and a previous frame (P)." *Intel* at par. 0024 "This application relates to **frame rate conversion of a video sequence and, more particularly, to methods for frame rate up-conversion**." *Intel* at par. 0001

11.a. retrieving **a plurality of images from a storage module**;	**A. US8358373** "Differences in the configuration from the conventional example shown in FIG. 1 are that **the same image detecting portion** 105 **that detects that the same images continue is added and the input image signal is input to the same image detecting portion** 105, and that the processing of the interpolation frame generating portion 106 is variably controlled based on a detection result from the same image detecting portion 105." *Sharp* at col. 13:42-49 "FIG. 24 shows an example of the processing procedures when hysteresis is applied to the same image detection in the same image detecting portion 105 or the same image detecting portion 107 in this way. **This processing needs a memory to hold a result of the same image detection in the previous frame**." *Sharp* at col. 26:53-58 **B. US9258519** "The encoder device 105 includes **a frame generator** 115, a modeler 120, **a partitioner** 160, a multimedia encoder 125, **a memory component** 130, a processor 135, and a receiver/transmitter 140. Processor 135 generally controls the overall operation of the exemplary encoder device 105." *Qualcomm* at col. 7:12-16 "**Partitioner component** 160 **partitions video frames into different blocks so that motion models may be associated with subset areas of the video frame**. Analysis of motion-deformation information may be successfully used to segment the initial scene/frame and may be used to determine the minimal temporal sampling of frames that need to be compressed and transmitted, in contrast to frames which can be successfully interpolated based on the data of the transmitted ones." *Qualcomm* at col. 7:17-25 "**Memory component** 130 **is used to store information such as raw video data** to be encoded, encoded video data to be transmitted, header information, the header directory, or intermediate data being operated on by the various encoder components." *Qualcomm* at col. 7:51-55

(cont.) 11.a. retrieving **a plurality of images from a storage module**;	**C. US20090161011** "FIG. 3 is an upper-level diagram showing the flow of a frame rate conversion (FRC) method 100, according to some embodiments. **The FRC method 100 takes as input a current frame (C) and a previous frame (P)**." *Intel* at par. 0024
11.b. generating **motion vectors according to the images**; and	**A. US8358373** "The FRC portion 100 includes **a motion vector detecting portion** 101 **that detects motion vector information from the input image signal**, an interpolation frame generating portion 106 that generates an interpolation frame based on the motion vector information acquired by the motion vector detecting portion 101, and a same image detecting portion 105 that detects a case where the same images continue in the input image signal." *Sharp* at col. 13:34-41 **B. US9258519** "Next, in step 404, **the motion vector information for the objects identified from the video data is processed. The motion vector information may be processed using the systems and methods disclosed in U.S. Patent Publication No. 2006/0018382 titled "Method and Apparatus for Motion Vector Processing," which is hereby expressly incorporated by reference herein in its entirety**. **In step** 405, **estimated affine models are associated with the moving objects**." *Qualcomm* at col. 10:50-57 **C. US20090161011** "**The FRC method** 100 **then performs motion estimation (ME)** 20, **which calculates motion vectors (MV)** 60, **and motion compensation (MC) interpolation** 70 **to generate a new frame**. The motion estimation 20 and motion compensation interpolation 70 operations are described in more detail below." *Intel* at par. 0024
11.c. **performing a plurality of different video/image processing operations, respectively**, wherein each of the video/image processing operations is **performed according to the motion vectors**;	**A. US8358373** "The FRC portion 100 includes the motion vector detecting portion 101 that detects motion vector information from the input image signal, **the interpolation frame generating portion** 106 **that generates an interpolation frame based on the motion vector information acquired by the motion vector detecting portion** 101, and a same image detecting portion 107 that detects a case where the same images continue in the input image signal." *Sharp* at col. 15:28-35

(cont.) 11.c. **performing a plurality of different video/image processing operations, respectively**, wherein each of the video/image processing operations is **performed according to the motion vectors**;	**B. US9258519** "In step 405, estimated affine models are associated with the moving objects. **The affine model may be estimated based on at least the degradation in the performance of the piecewise planar motion vector field approximation**. **Each affine model associated with each identified moving object is specified in step** 406 **using motion vector erosion information**, as discussed in further detail with reference to FIG. 5, and is then further specified in step 407 using motion based object segmentation." *Qualcomm* at col. 10:56-64 "Several **motion prediction techniques may be used for video compression** in addition to translational motion. **Additional motion types include:** rotational motion; Zoom-in and Zoom-out motion; deformations, where changes in the structure and morphology of scene objects violate the assumption of a rigid body; **affine motion**; global motion; and object based motion. **Affine motion models support multiple motion types, including translational motion, rotational motion, shearing, translation, deformations and object scaling for use in Zoom-in and Zoom-out scenarios**." *Qualcomm* at col. 5:44-53 **C. US20090161011** "In some embodiments, there exist two options for generating the new frame in the FRC method 100. **First, motion compensation may be performed, using the motion estimation, as illustrated in FIGS. 3 and 4**. **In this case, the missing frame pixels will be taken from adjacent frames according to the calculated motion vectors**, **using an appropriate interpolation method**. Second, the frames may simply be duplicated (drop/repeat) from the nearest frame (depending on the time stamp). In some embodiments, the FRC method 100 uses the duplication method in two cases: where there is no judder artifact and where the artifact caused by motion compensation may be stronger than the perceived judder." *Intel* at par. 0040
11.d. wherein **the video/image processing operations comprise at least one of a first video/image processing operation** and **a**	**A. US8358373** "The FRC portion 100 includes the motion vector detecting portion 101 **that detects motion vector information from the input image signal, the interpolation frame generating**

second video/image processing operation;	**portion** 106 **that generates an interpolation frame based on the motion vector information acquired by the motion vector detecting portion** 101, **and a same image detecting portion** 107 **that detects a case where the same images continue in the input image signal**." *Sharp* at col. 15:28-35 "A difference from the exemplary configuration of the FRC drive display circuit shown in FIG. 6 is that **the same image detecting portion** 107 **is used to detect that the same images continue based on a motion vector signal output from the motion vector detecting portion** 101." *Sharp* at col. 15:36-40
11.e. the first video/image processing operation comprises: **performing frame rate conversion according to the received motion vectors**; and	**A. US8358373** "The interpolation vector evaluating portion 54 evaluates the input motion vector and allocates an optimum interpolation vector to the interpolation block between frames to output to the interpolation frame generating portion 55 based on the evaluation result. **The interpolation frame generating portion** 55 **generates an interpolation frame with the use of the input image signal of the immediately previous frame and the input image signal of the current frame based on the interpolation vector input from the interpolation vector evaluating portion** 54. The time base converting portion 56 alternately outputs the input frame and the interpolation frame to **output an image signal having a frame rate twice as high as that of the original input image signal**." *Sharp* at col. 18:16-28 **B. US9258519** "Certain aspects disclosed herein provide an **Encoder Assisted Frame Rate Up Conversion (EA-FRUC) system that utilizes various motion models** in addition to video coding and pre-processing operations at the video encoder to exploit the FRUC processing that will occur in the decoder in order to improve the modeling of moving objects, compression efficiency and reconstructed video quality." *Qualcomm* at col. 3:41-47 "In step 405, estimated affine models are associated with the moving objects. **The affine model may be estimated based on at least the degradation in the performance of the piecewise planar motion vector field approximation**. **Each affine model associated with each identified moving object is specified in step** 406 **using motion vector erosion information**, as discussed in further detail with reference to

(cont.) 11.e. the first video/image processing operation comprises: **performing frame rate conversion according to the received motion vectors**; and	FIG. 5, and is then further specified in step 407 using motion based object segmentation." *Qualcomm* at col. 10:56-64 **C. US20090161011** "In the FRC method 100, there is no need to estimate a motion vector for each pixel. Instead, **using global image analysis, global motion is detected for the whole scene and/or for major objects within the scene**. **Motion vectors** 60 **are generated only for significant selected objects in the frame**. Thus, the probability of artifacts occurring using the FRC method 100 is significantly mitigated, in some embodiments." *Intel* at par. 0045 "**FIGS. 9 and 10 show the same image being frame rate up-converted**, with significantly different results. In FIG. 9, **motion compensation using the prior art block-based motion compensation (motion vector per block) method, described above, is used for frame rate up-conversion**. In FIG. 10, **the FRC method** 100 **using global estimation is used for frame rate up-conversion.** Thus, the FRC method 100 generates reduced interpolation artifacts, relative to prior art methods." *Intel* at par. 0046
11.f. the second video/image processing operation comprises: **encoding the images to generate a compressed bit-stream according to the received motion vectors**.	**A. US8358373** "For the interpolation image between the frames # 4 and #5, the interpolation image generating processing 39 that has **received a same image detecting signal** 43 **from the same image detecting processing** 33 **for the immediately previous frames** # 3 and #4 **performs the interpolation image generating processing with the motion compensation processing made ineffective** as described above with FIGS. 13 to 19 to output an interpolation frame #4.5. In this case, there is no motion since the immediately previous frames # 3 and #4 are the same images, and there is also no motion since the next frames # 4 and #5 are the same images. That is, the continuity of the motion is maintained and the vector detection errors caused by the absence of the motion continuity do not occur. Therefore, no problem occurs even when the interpolation image generating processing using the motion compensation processing is performed in the interpolation image generating processing 39, and there is also no problem since the **image quality deterioration is not caused even when the interpolation image generating processing with the motion compensation processing made**

(cont.) 11.f. the second video/image processing operation comprises: **encoding the images to generate a compressed bit-stream according to the received motion vectors**.	**ineffective is performed** as described above." *Sharp* at col. 23:11-31 **B. US9258519** "Taking advantage of the knowledge that FRUC will be performed in the decoder, the **EA FRUC system utilizes various motion models, video coding** and pre-processing operations **at the video encoder to improve compression efficiency** (thereby improving utilization of transmission bandwidth) and reconstructed video quality, including the representation of reconstructed moving objects." *Qualcomm* at col. 5:22-29 "In step 405, estimated affine models are associated with the moving objects. **The affine model may be estimated based on at least the degradation in the performance of the piecewise planar motion vector field approximation**. **Each affine model associated with each identified moving object is specified in step** 406 **using motion vector erosion information**, as discussed in further detail with reference to FIG. 5, and is then further specified in step 407 using motion based object segmentation." *Qualcomm* at col. 10:56-64 "First, in step 301, modeling information is determined for objects in a video frame, as discussed in further detail with reference to FIG. 4. Next, in step 302, information on the decoding system intended to be used to decode the encoded video data is used in order to further upsample the encoded video. Finally, in step 303, the **encoded video bitstream is generated**, as discussed in U.S. Patent Publication No. 2006/0002465 titled "Method and Apparatus for Using Frame Rate Up Conversion Techniques in Scalable Video Coding," which is hereby expressly incorporated by reference herein in its entirety." *Qualcomm* at col. 9:25-35