(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 October 2013 (31.10.2013)

WIPO | PCT

(10) International Publication Number
WO 2013/160694 A4

(51) International Patent Classification:
H04N 7/26 (2006.01)

(21) International Application Number:
PCT/GB2013/051071

(22) International Filing Date:
26 April 2013 (26.04.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

1207459.7	26 April 2012 (26.04.2012)	GB
1211628.1	29 June 2012 (29.06.2012)	GB
1211629.9	29 June 2012 (29.06.2012)	GB
1211623.2	29 June 2012 (29.06.2012)	GB

(71) Applicant: **SONY CORPORATION** [JP/JP]; 1-7-1 Konan, Minato-ku, Tokyo 108-0075 (JP).

(71) Applicant *(for JP only)*: **SONY EUROPE LIMITED** [GB/GB]; The Heights, Brooklands, Weybridge, Surrey KT13 0XW (GB).

(72) Inventors: **GAMEI, James Alexander**; 34 Norbiton Hall, London Road, Kingston-upon-Thames, Surrey KT2 6RB (GB). **SAUNDERS, Nicholas Ian**; 21 Mongers Piece, Chineham, Basingstoke, Hampshire RG24 8RL (GB). **SHARMAN, Karl James**; 6 Tadburn Close, Chandler's Ford, Eastleigh H SO53 2NF (GB). **SILCOCK, Paul James**; 50 Sevenfields, Highworth, Swindon SN6 7NF (GB).

(74) Agent: **TURNER, James**; 120 Holborn, London EC1N 2DY (GB).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *with amended claims (Art. 19(1))*

Date of publication of the amended claims: 3 January 2014

(54) Title: MODE-DEPENDENT COEFFICIENT SCANNING AND DIRECTIONAL TRANSFORMS FOR DIFFERENT COLOUR SAMPLING FORMATS

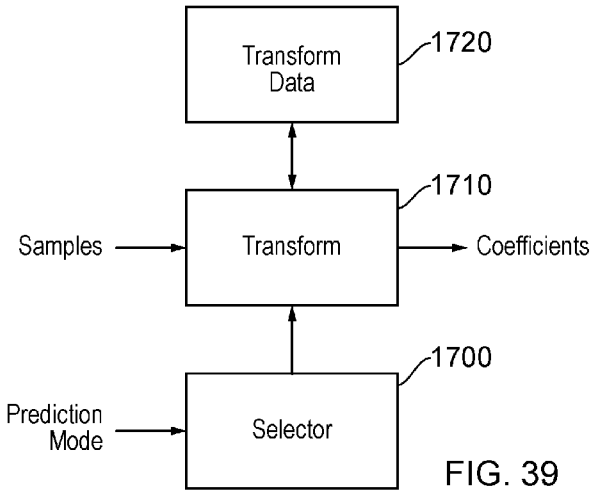

FIG. 39

(57) Abstract: A method of coding 4:2:2 or 4:4:4 video data comprises predicting luminance and/or chrominance samples of an image from other respective reference samples derived from the same image according to a prediction mode associated with a sample to be predicted, the prediction mode being selected for each of a plurality of blocks of samples, from a set of two or more candidate prediction modes; detecting differences between the samples and the respective predicted samples; selecting a frequency-separation transform from two or more candidate frequency separation transforms according to the prediction mode associated with a current block of samples using a mapping between transform and prediction mode, the mapping between different, as between chrominance and luminance samples, for at least the 4:4:4: format; and encoding the detected differences by frequency-separating the differences, using the selected frequency-separation transform.

WO 2013/160694 A4

AMENDED CLAIMS
received by the International Bureau on 25 November 2013 (25.11.2013)

1. Apparatus for decoding video data in which differences between predicted and original samples are frequency-separated and encoded, comprising:

a predictor configured to predict luminance and/or chrominance samples of an image from other respective reference samples derived from the same image according to a prediction mode associated with a sample to be predicted, the prediction mode being selected for each of a plurality of blocks of samples, from a set of two or more candidate prediction modes;

a selector configured to select a scan pattern from a set of two or more candidate scan patterns, each scan pattern defining an order of encoding the set of frequency-separated coefficients, in dependence upon the prediction mode for that block of samples using a mapping between scan pattern and prediction mode, the mapping being different, as between chrominance and luminance samples; and

a decoder configured to decode frequency-separated difference data representing a frequency-separated version of data indicative of differences between the samples to be decoded and respective predicted samples, in an order of frequency-separated coefficients according to the selected scan pattern.

2. Apparatus for coding video data in which differences between predicted and original samples are frequency-separated and encoded, comprising:

a predictor configured to predict luminance and/or chrominance samples of an image from other respective reference samples derived from the same image according to a prediction mode associated with a sample to be predicted, the prediction mode being selected for each of a plurality of blocks of samples, from a set of two or more candidate prediction modes;

a detector configured to detect differences between the samples and the respective predicted samples;

a transform unit configured to frequency-separate the detected differences for a block of samples, using a frequency-separation transform, to generate a corresponding set of frequency-separated coefficients;

a selector configured to select a scan pattern from a set of two or more candidate scan patterns, each scan pattern defining an order of encoding the set of frequency-separated coefficients, in dependence upon the prediction mode for that block of samples; and

an encoder configured to encode the frequency-separated difference data in an order of frequency-separated coefficients according to the selected scan pattern.

3. A method of coding video data in which differences between predicted and original samples are frequency-separated and encoded, comprising:

predicting luminance and/or chrominance samples of an image from other respective reference samples derived from the same image according to a prediction mode associated with a sample to be predicted, the prediction mode being selected for each of a plurality of blocks of samples, from a set of two or more candidate prediction modes;

detecting differences between the samples and the respective predicted samples;

frequency-separating the detected differences for a block of samples, using a frequency-separation transform, to generate a corresponding set of frequency-separated coefficients;

selecting a scan pattern from a set of two or more candidate scan patterns, each scan pattern defining an order of encoding the set of frequency-separated coefficients, in dependence upon the prediction mode for that block of samples using a mapping between scan pattern and prediction mode, the mapping being different, as between chrominance and luminance samples; and

encoding the frequency-separated difference data in an order of frequency-separated coefficients according to the selected scan pattern.

4. A method according to claim 3, in which the prediction mode associated with a block of samples to be predicted indicates a prediction direction defining one or more other respective reference samples from which each sample of that block is to be predicted.

5. A method according to claim 3 or claim 4, comprising:

providing a mapping between prediction mode and scan pattern.

6. A method according to claim 5, in which the video data comprises 4:2:2 and/or 4:4:4 video data and the mapping is different for 4:2:2 luminance and 4:2:2 chrominance data.

7. A method according to claim 5 or claim 6, in which in which the video data comprises 4:2:2 and/or 4:4:4 video data and the mapping is different for 4:2:2 and 4:4:4 video data.

8. A method according to any one claims 3 to 7, in which the size of a current block of luminance samples is 4x4 or 8x8 samples.

9. A method according to any one of the claims 3 to 8, comprising:

selecting the size of the current block of samples from a set of candidate sizes;

applying the step of selecting a scan pattern if the selected block size is one of a predetermined subset of the set of candidate sizes.

10. A method according to any one of claims 3 to 9, comprising:

applying the step of selecting a scan pattern only in respect of luminance samples.

11. A method according to any one of claims 3 to 10, in which the set of candidate scan patterns is different for use in respect of luminance and chrominance samples.

12. A method according to any one of claims 3 to 11, in which the selecting step is configured to select a horizontal scan pattern in respect of a set of predominantly horizontal prediction modes, to select a vertical scan pattern in respect of a set of predominantly vertical prediction modes, and to select a diagonal scan pattern in respect of other prediction modes.

13. A method of decoding video data in which differences between predicted and original samples are frequency-separated and encoded, comprising:

predicting luminance and/or chrominance samples of an image from other respective reference samples derived from the same image according to a prediction mode associated with a sample to be predicted, the prediction mode being selected for each of a plurality of blocks of samples, from a set of two or more candidate prediction modes;

selecting a scan pattern from a set of two or more candidate scan patterns, each scan pattern defining an order of encoding the set of frequency-separated coefficients, in dependence upon the prediction mode for that block of samples using a mapping between scan pattern and prediction mode, the mapping being different, as between chrominance and luminance samples; and

decoding frequency-separated difference data representing a frequency-separated version of data indicative of differences between the samples to be decoded and respective predicted samples, in an order of frequency-separated coefficients according to the selected scan pattern.

14. A method according to any one of claims 3 to 13, in which the video data is 4:2:2 or 4:4:4 video data.

15. A method according to any one of claims 3 to 14, in which the mapping is different, as between chrominance and luminance samples, for at least the 4:4:4 format.

16. A method of coding 4:2:2 or 4:4:4 video data, comprising:

predicting luminance and/or chrominance samples of an image from other respective reference samples derived from the same image according to a prediction mode associated with a sample to be predicted, the prediction mode being selected for each of a plurality of blocks of samples, from a set of two or more candidate prediction modes;

detecting differences between the samples and the respective predicted samples;

selecting a frequency-separation transform from two or more candidate frequency separation transforms according to the prediction mode associated with a current block of samples using a mapping between transform and prediction mode, the mapping being different, as between chrominance and luminance samples, for at least the 4:4:4: format; and

encoding the detected differences by frequency-separating the differences, using the selected frequency-separation transform.

17. A method according to claim 16, in which the candidate frequency-separation transforms comprise two or more transforms selected from the list consisting of:

the discrete cosine transform;

the discrete sine transform;

the Karhunen-Loeve transform; and

transforms defined by respective row and column matrices for matrix-multiplication by the current block of samples.

18. A method according to claim 17, in which the prediction mode associated with a block of samples to be predicted indicates a prediction direction defining one or more other respective reference samples from which each sample of that block is to be predicted.

19. A method according to any one of claims 16 to 18, comprising:

providing a mapping between prediction mode and frequency-separation transform.

20. A method according to claim 19, in which the mapping is different between luminance and chrominance data for the 4:2:2 format.

21. A method according to any one of claims 16 to 20, in which the size of a current block of luminance samples is 4x4 samples.

22. A method according to any one of the claims 16 to 21, comprising:

selecting the size of the current block of samples from a set of candidate sizes;

applying the step of selecting a frequency-separation transform if the selected block size is one of a predetermined subset of the set of candidate sizes.

23. A method according to any one of claims 16 to 22, in which the step of encoding the detected differences comprises:

selecting a scan pattern from a set of two or more candidate scan patterns, each scan pattern defining an order of encoding the set of frequency-separated coefficients, in dependence upon the prediction mode for that block of samples; and

encoding the frequency-separated difference data in an order of frequency-separated coefficients according to the selected scan pattern.

24. A method of decoding 4:2:2 or 4:4:4 video data, comprising:

predicting luminance and/or chrominance samples of an image from other respective reference samples derived from the same image according to a prediction mode associated with a sample to be predicted, the prediction mode being selected for each of a plurality of blocks of samples, from a set of two or more candidate prediction modes;

selecting a frequency-separation transform from two or more candidate frequency separation transforms according to the prediction mode associated with a current block of samples using a mapping between transform and prediction mode, the mapping being different, as between chrominance and luminance samples, for at least the 4:4:4: format; and

decoding difference data indicative of differences between the samples to be decoded and respective predicted samples, using the selected frequency-separation transform.

25. Computer software which, when executed by a computer, causes the computer to carry out a method according to any one of claims 3 to 24.

26. A machine-readable non-transitory storage medium which stores software according to claim 25.

27. A data signal comprising coded data generated according to the method of any one of claims 3 to 24.

28. Apparatus for coding 4:2:2 or 4:4:4 video data, comprising:

a predictor configured to predict luminance and/or chrominance samples of an image from other respective reference samples derived from the same image according to a

prediction mode associated with a sample to be predicted, the prediction mode being selected for each of a plurality of blocks of samples, from a set of two or more candidate prediction modes;

a detector configured to detect differences between the samples and the respective predicted samples;

a selector configured to select a frequency-separation transform from two or more candidate frequency separation transforms according to the prediction mode associated with a current block of samples using a mapping between transform and prediction mode, the mapping being different, as between chrominance and luminance samples, for at least the 4:4:4: format; and

an encoder configured to encode the detected differences by frequency-separating the differences, using the selected frequency-separation transform.

29. Apparatus for decoding 4:2:2 or 4:4:4 video data, comprising:

a predictor configured to predict luminance and/or chrominance samples of an image from other respective reference samples derived from the same image according to a prediction mode associated with a sample to be predicted, the prediction mode being selected for each of a plurality of blocks of samples, from a set of two or more candidate prediction modes;

a selector configured to select a frequency-separation transform from two or more candidate frequency separation transforms according to the prediction mode associated with a current block of samples using a mapping between transform and prediction mode, the mapping being different, as between chrominance and luminance samples, for at least the 4:4:4: format; and

a decoder configured to decode difference data indicative of differences between the samples to be decoded and respective predicted samples, using the selected frequency-separation transform.

30. Video storage, transmission, capture or display apparatus comprising apparatus according to any one of claims 1, 2, 28 and 29.