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[Continued on next page]

(54) Title: FACE RELIGHTING FROM A SINGLE IMAGE

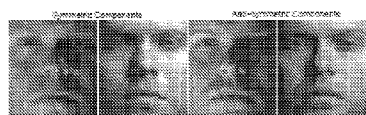
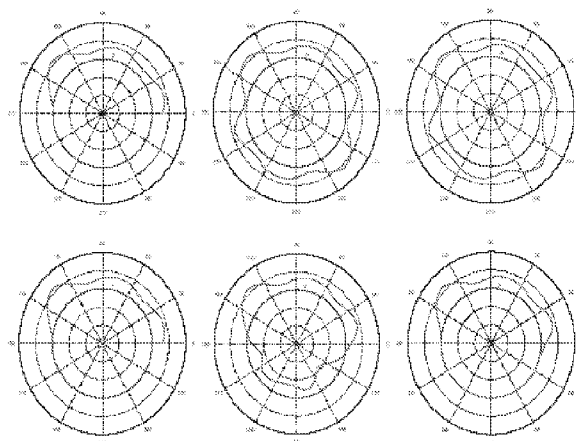


Figure 1

(57) Abstract: Disclosed is a method for estimating the ap-
parent bi-directional reflectance distribution function field
of a human face using anti-symmetric tensor splines, com-
prising: defining the complex geometry and reflectance
properties of the human face by a field of spherical func-
tions; approximating the field of spherical functions by
anti-symmetric higher-order Cartesian tensors within a sin-
gle pixel; applying a B-spline basis as the weighting func-
tion of the anti-symmetric higher-order Cartesian tensors;
fitting the tensor spline basis to a given set of two-dimen-
sional facial images of a human subject with a fixed pose
and associated lighting directions by minimizing the ener-
gy of an objective function with respect to the unknown
tensor coefficients of said anti-symmetric higher-order
Cartesian tensors; and analytically computing the deriva-
tives of the objective function for its efficient minimiza-
tion.

**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- *of inventorship (Rule 4.17(iv))*

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A. CLASSIFICATION OF SUBJECT MATTER

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USPC - 382/118

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
382/100, 103, 107, 108, 115-118, 154, 162, 165, 168, 173, 181, 193-194, 199, 209, 220, 232, 254, 274, 276, 285-298, 312; 348/94; 345/418-420

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWest (PGPB, USPT, EPAB, JPAB); Google (Patents and Scholar)

Search Terms: Reflectance or reverberate or return, Bi-directional, Fac\$3 or human or head, Anti-symmetric, Tensor, Spline\$ or b-spline, Spherical, Function\$2 or equation\$ or algorithm, Approximat\$ or estimate\$, Weight\$3 or measure\$5, Derivative or derive or secondary

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2006/0280342 A1 (Lee et al.) 14 December 2006 (14.12.2006), entire document, especially Fig 3-4 and para [0004]-[0034]	1-35
Y	US 7,215,802 B2 (Klingensmith et al.) 8 May 2007 (08.05.2007), entire document, especially col 2, ln 11-col 10, ln 17	1-8, 12-17, 21-30
Y	US 2007/0014435 A1 (Mirowsky et al) 18 January 2007 (18.01.2007), entire document, especially para [0055]	9-11, 18-20, 31-35
A	US 2007/0031028 A1 (Vetter et al.) 8 February 2007 (08.20.2007), entire document	1-35

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"&" document member of the same patent family

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