Supplementary material for
'SalientShape: Group Saliency in Image Collections'

Ming-Ming Cheng[1,4]   Niloy J. Mitra[2]   Xiaolei Huang[3]   Shi-Min Hu[1]

[1] TNList, Tsinghua University, Beijing   [2] UCL   [3] Lehigh University   [4] Oxford Brookes University

1. Benchmark Database

In order to evaluate the effectiveness of our proposed method, we introduce a labeled dataset of categorized images initially obtained by using query keywords from Flickr. We downloaded about 3,000 images for each of the 5 keywords: 'butterfly', 'coffee mug', 'dog jump', 'giraffe', and 'plane'. Thus there is a total of 15,000 images in our database. For each image, if there is a salient object that matches the query keyword and most parts of the object is visible, we mark the object region at pixel accuracy to provide ground truth labeling of the object. Some images in the database do not contain any salient region that matches the query; we do not label them in this case, resulting about 6,000 images with pixel accuracy ground truth salient region maps. Table 1 shows some statistics about this dataset. Among these image categories, only a fraction $(15\% - 57\%)$ of the images contain target objects. The percentage of images that do contain the target object (i.e. target ratio) is listed for each category in Table 1. We provide ground truth labeling for each image that contains a target. Note also, that these objects may have different color, texture, and shape. Even a single object may be composed of several regions with very different appearance (e.g.butterfly). Examples of images in the dataset as well as corresponding ground truth labeling can be found in Figures 3-52.

To the best of our knowledge, our benchmark dataset with pixel accuracy salient object region ground truth labeling is the largest of its kind. (It contains 15 times more images than previously largest public available benchmark [AHES09]) .

We will make the benchmark and our binary source code publicly available.

2. Details about Results Evaluation

2.1. Global Color Priors

Figure 1 illustrates the global color priors of each image group. These color statistics are consistent with our understanding of the corresponding keywords. Butterflies have vivid colors and they very likely appear in pictures with green background regions. Coffee mugs have more varieties of colors than other image groups. Many dogs have yellow or dark colors and they like to play on green grass fields. Yellow giraffe often appears in images with green (corresponding to trees and grass) or blue (corresponding to sky in the upper portion of an image) background regions. Many airplanes appear with blue (corresponding to sky) or green (corresponding to ground) background. The probability $p(f|c)$ of each color c belonging to the foreground region can be estimated according to Bayes rule:

$$p(f|c) = \frac{p(c|f)p(f)}{p(c|f)p(f) + p(c|b)p(b)}, \quad (1)$$

where $p(c|f)$ and $p(c|b)$ are given by the foreground and background color statistics, and $p(f)$ and $p(b)$ can be approximated by the corresponding distributions of color samples selected based on the group saliency prior. Since there are typically more background pixels than foreground pixels, more $p(f|c)$ is below 0.5 as illustrated in Figure 1. The selected color samples are sparse and do not necessarily cover all representative colors of foreground and background regions.

2.2. Runtime Efficiency

Table 2 shows the runtime for processing each group. Although the entire process takes about 30 min for each group, most of the processing is done offline, and at retrieval runtime, we only need to compare object shapes with user-input
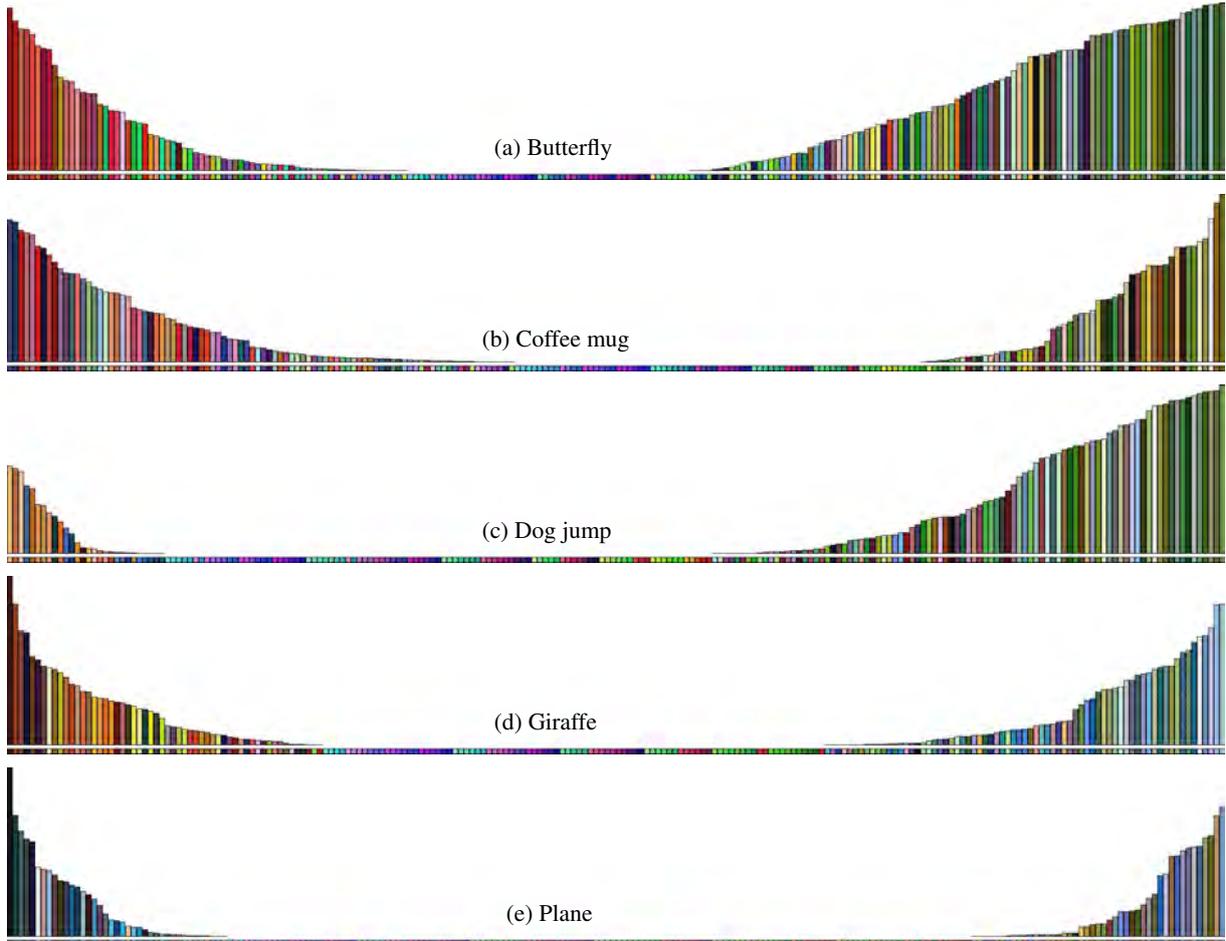
	# Images	# G-Truth	Target ratio
Butterfly	3457	1242	35.9%
Coffee Mug	3282	1884	57.4%
Dog Jump	2893	1614	55.8%
Giraffe	2933	461	15.7%
Plane	2970	1032	34.7%

Table 1: *Statistics about our benchmark dataset.*

(a) Butterfly

(b) Coffee mug

(c) Dog jump

(d) Giraffe

(e) Plane

Figure 1: *Illustration of color statistics about group saliency prior of each group. We uniformly find $6 \times 6 \times 6 = 216$ color samples c from RGB color space and illustrate their probabilities $p(f|c)$ to be foreground target purely according to global color statistics. From left to right, we show colors according to decreasing order of $p(f|c)$. The height of each histogram bin is $abs(p(f|c) - 0.5)$. The left side of each histogram mainly corresponds to colors of target foreground regions and the right side corresponds to colors of background regions.*

	Pre-processing time	Retrieval run-time
Butterfly	31.5 min	0.98 s
Coffee mug	31.9 min	0.90 s
Dog jump	29.5 min	0.83 s
Giraffe	27.1 min	0.83 s
Plane	32.2 min	0.89 s

Table 2: *Runtime for each image group.*

shape when a new user-input sketch is given, which takes about 1 second for each group.

2.3. Sketch based Image Retrieval

Figure 2-6 show examples of sketch based image retrieval using Flickr, our method, as well as SHoG [EH-

BA11] method for additional 25 categories. Detailed statistics about the retrieval results are in the main paper.

2.4. Salient Region Detection & Segmentation

Example results of our method are shown in Figures 7-56. These images correspond to one of the five keywords: 'butterfly' (Figure 7-16), 'coffee mug' (Figure 17-26), 'dog jump' (Figure 27-36), 'giraffe' (Figure 37-46), and 'plane' (Figure 47-56). In each row from left to right, we show the source image, result by a single image saliency detection methods FT [AHES09], SEG [RKSH10], RC [CZM*11], group saliency map after 1st iteration, group saliency map after 2nd iteration, group saliency segmentation result, and ground truth labeling. For some images, their group saliency segmentation may contain no foreground regions, resulting

in empty saliency maps and segmentation results. Objective evaluation about the saliency region segmentation results are shown in the main paper, which clearly outperforms single image saliency segmentation methods, in terms of higher F_β measure.

References

[AHES09] ACHANTA R., HEMAMI S., ESTRADA F., SÜSSTRUNK S.: Frequency-tuned salient region detection. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)* (2009), pp. 1597–1604.

[CZM*11] CHENG M.-M., ZHANG G.-X., MITRA N. J., HUANG X., HU S.-M.: Global contrast based salient region detection. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)* (2011), pp. 409–416.

[EHBA11] EITZ M., HILDEBRAND K., BOUBEKEUR T., ALEXA M.: Sketch-based image retrieval: benchmark and bag-of- features descriptors. *IEEE Transactions on Visualization and Computer Graphics (TVCG) 17* (2011), 1624–1636.

[RKSH10] RAHTU E., KANNALA J., SALO M., HEIKKILA J.: Segmenting salient objects from images and videos. *European Conference on Computer Vision (ECCV)* (2010), 366–379.

(a) Bottle　　　　(b) Cake　　　　(c) Cattle　　　　(d) Cow　　　　(e) Crow

Figure 2: *SBIR comparison. In each group from left to right, first column shows images downloaded from Flickr using the corresponding keyword; second column shows our retrieval results; third column shows corresponding sketch based retrieval results using SHoG [EHBA11].*
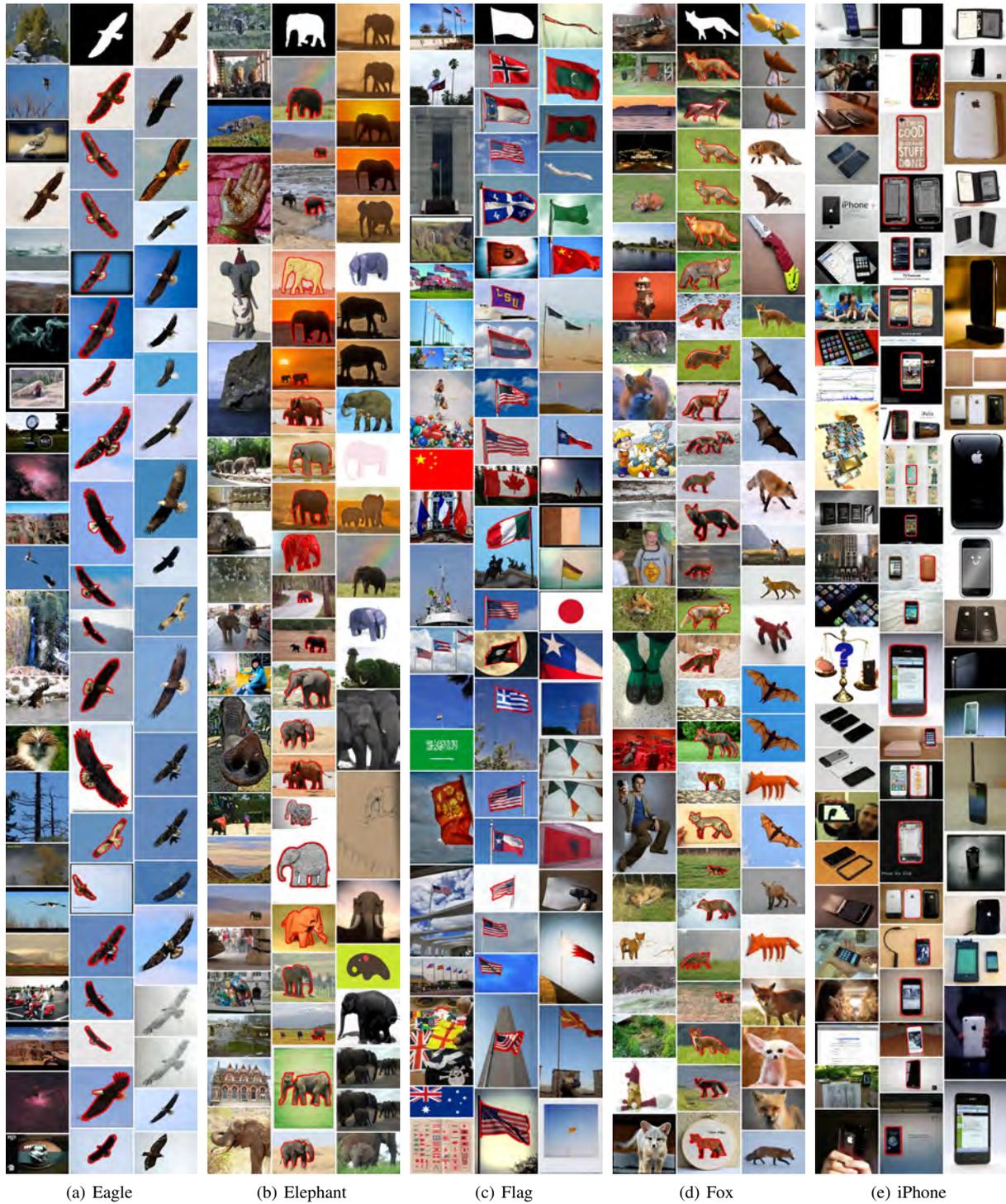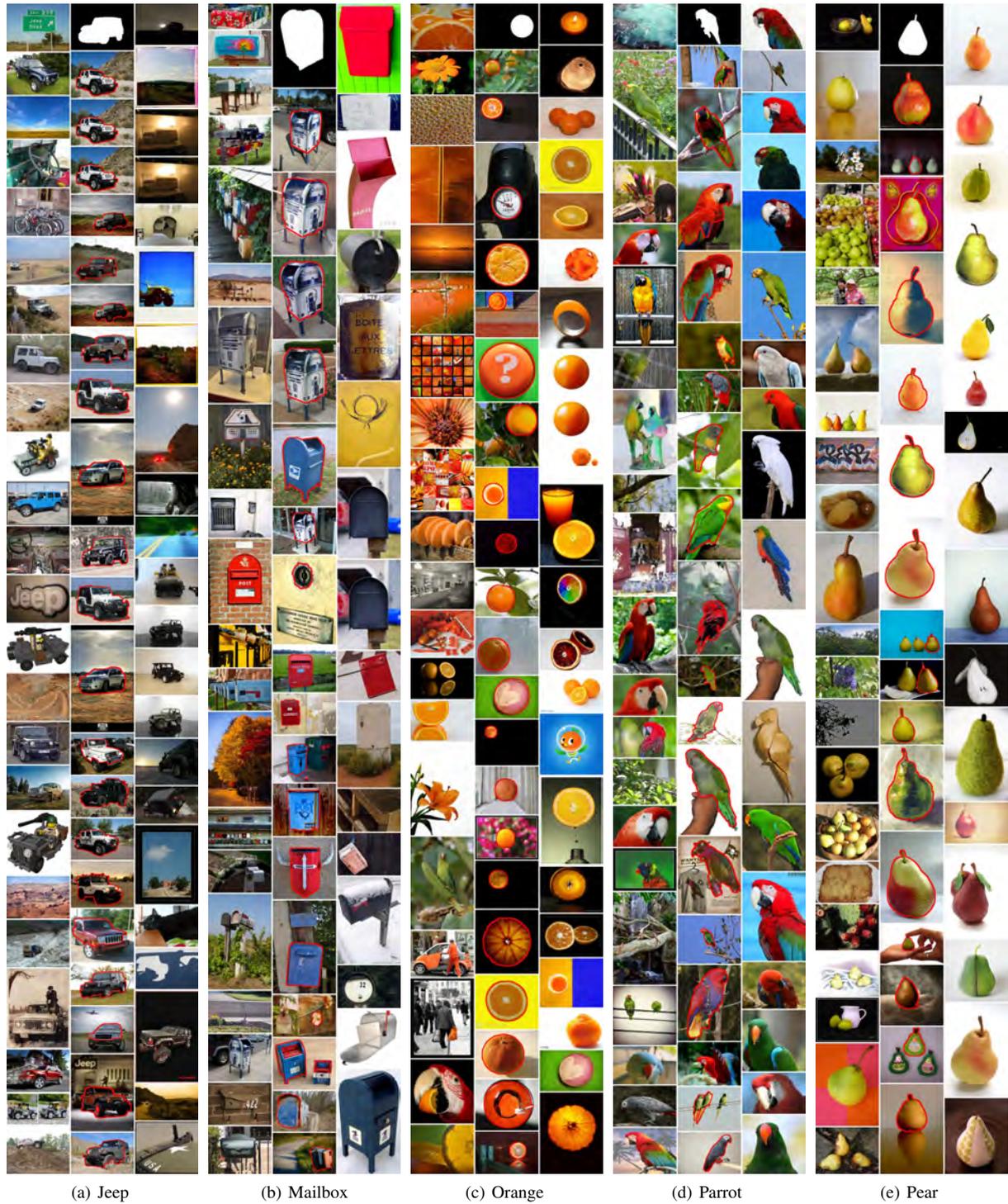
(a) Eagle   (b) Elephant   (c) Flag   (d) Fox   (e) iPhone

Figure 3: *SBIR comparison. In each group from left to right, first column shows images downloaded from Flickr using the corresponding keyword; second column shows our retrieval results; third column shows corresponding sketch based retrieval results using SHoG [EHBA11].*
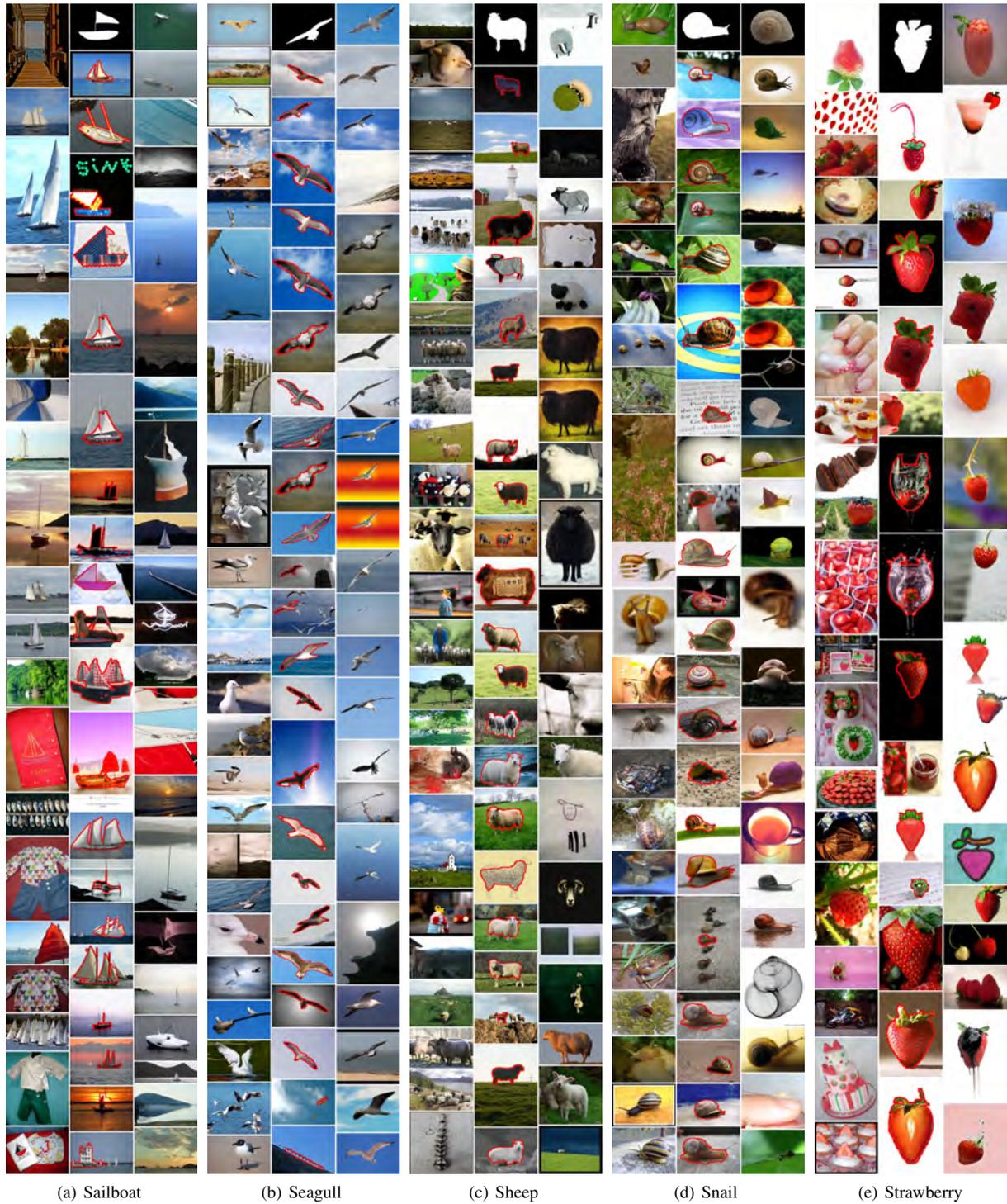
(a) Jeep   (b) Mailbox   (c) Orange   (d) Parrot   (e) Pear

Figure 4: *SBIR comparison. In each group from left to right, first column shows images downloaded from Flickr using the corresponding keyword; second column shows our retrieval results; third column shows corresponding sketch based retrieval results using SHoG [EHBA11].*
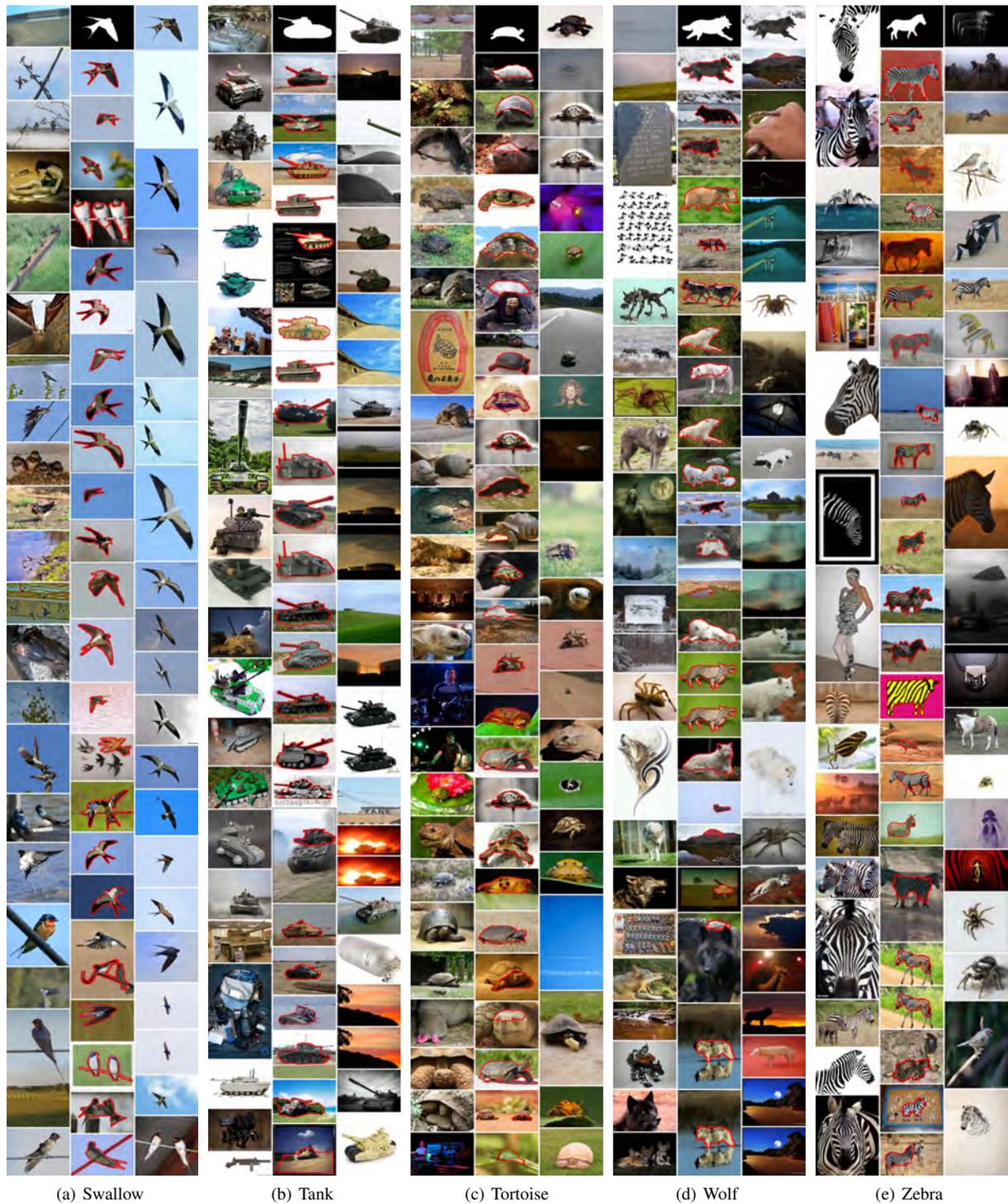
(a) Sailboat (b) Seagull (c) Sheep (d) Snail (e) Strawberry

Figure 5: *SBIR comparison. In each group from left to right, first column shows images downloaded from Flickr using the corresponding keyword; second column shows our retrieval results; third column shows corresponding sketch based retrieval results using SHoG [EHBA11].*
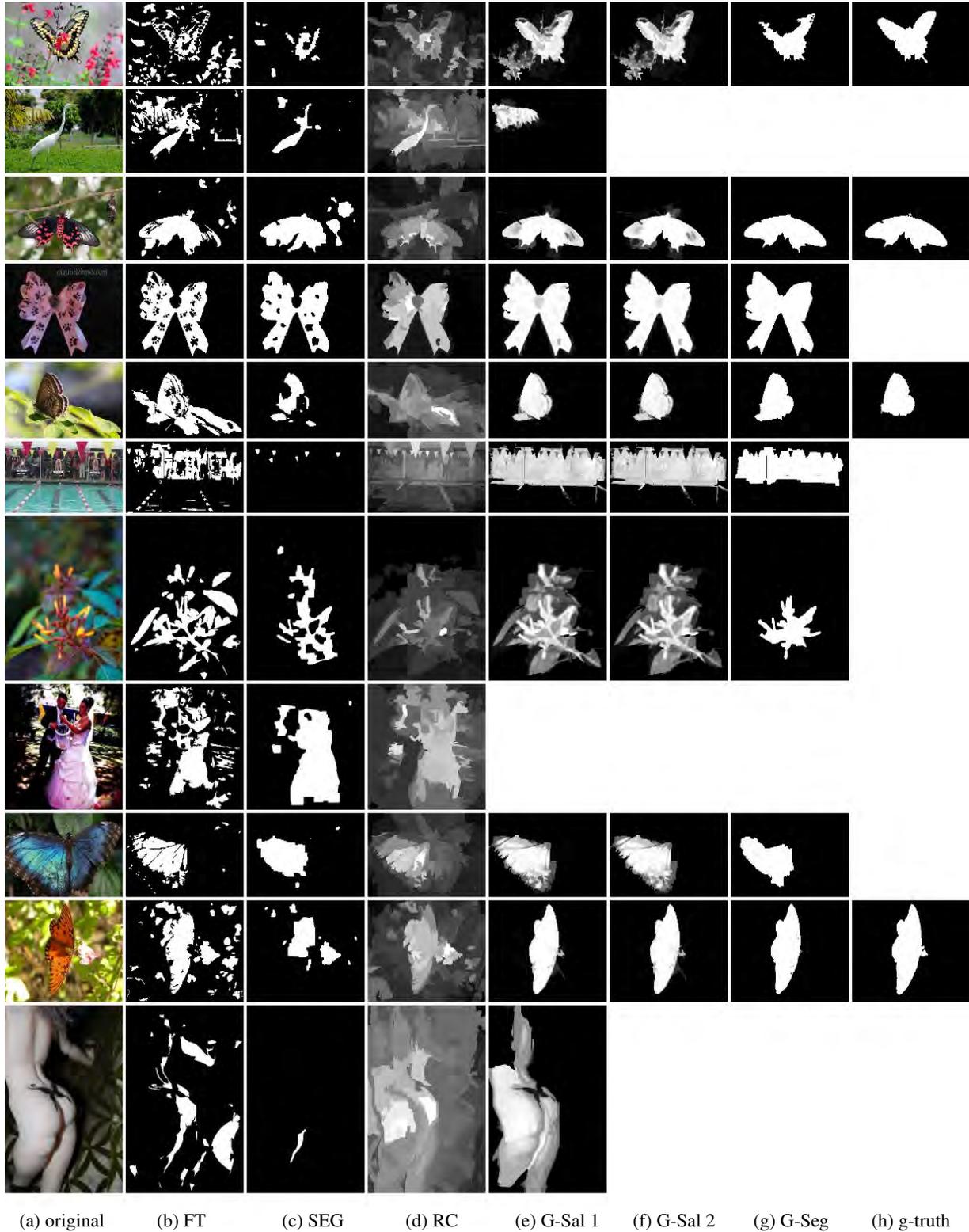
| (a) Swallow | (b) Tank | (c) Tortoise | (d) Wolf | (e) Zebra |

Figure 6: *SBIR comparison. In each group from left to right, first column shows images downloaded from Flickr using the corresponding keyword; second column shows our retrieval results; third column shows corresponding sketch based retrieval results using SHoG [EHBA11].*

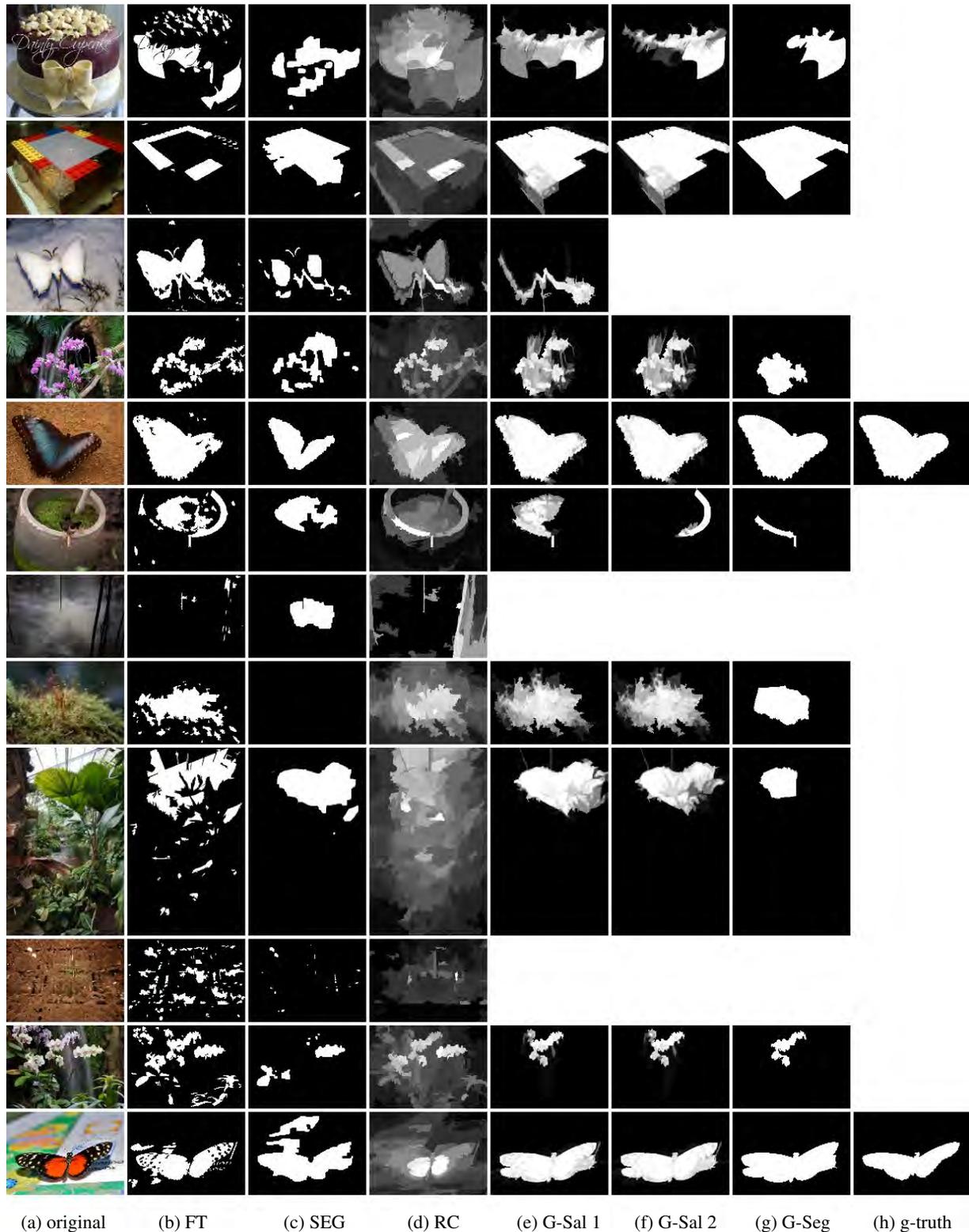　(a) original　　　(b) FT　　　(c) SEG　　　(d) RC　　(e) G-Sal 1　　(f) G-Sal 2　　(g) G-Seg　　(h) g-truth

Figure 7: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
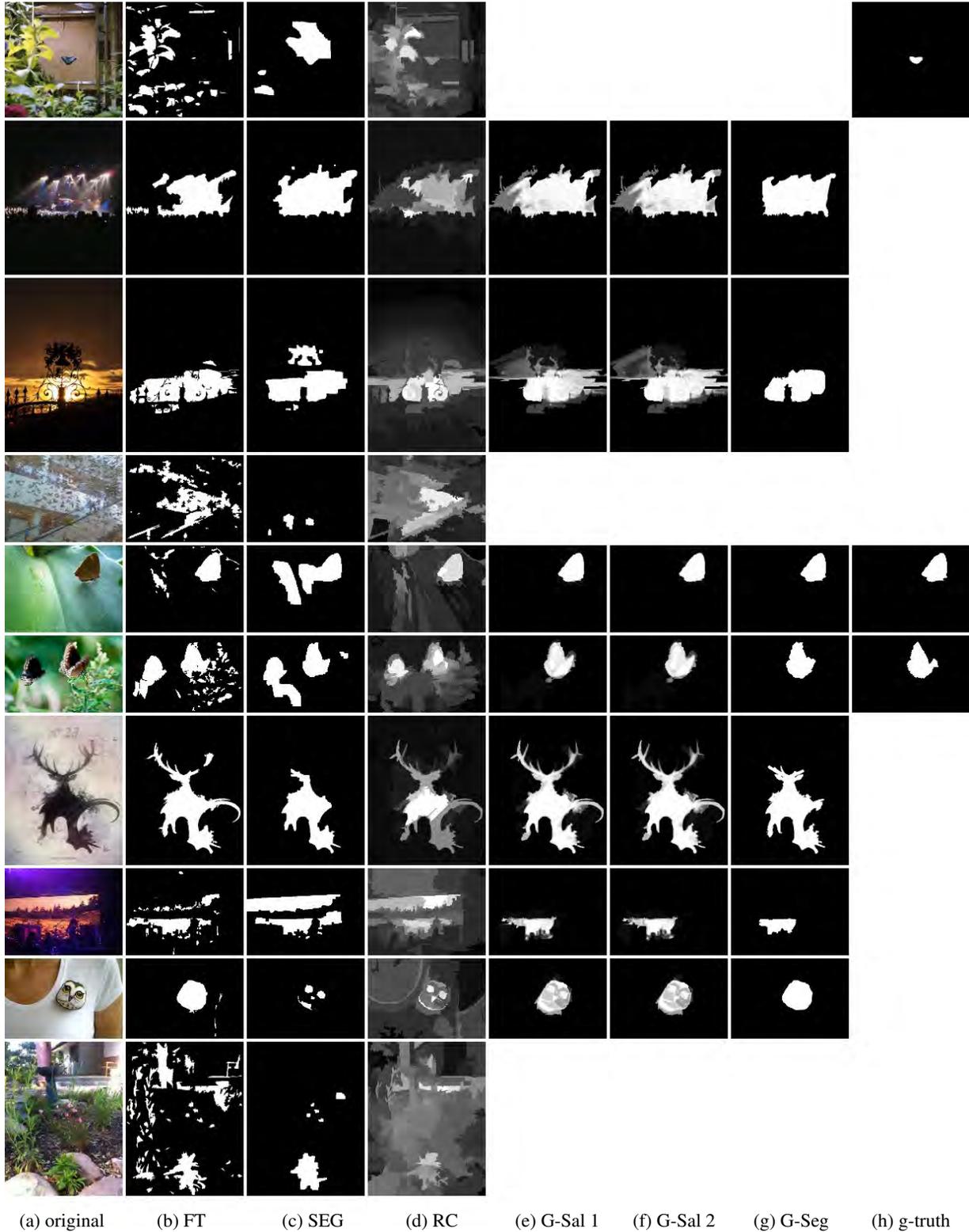
Figure 8: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
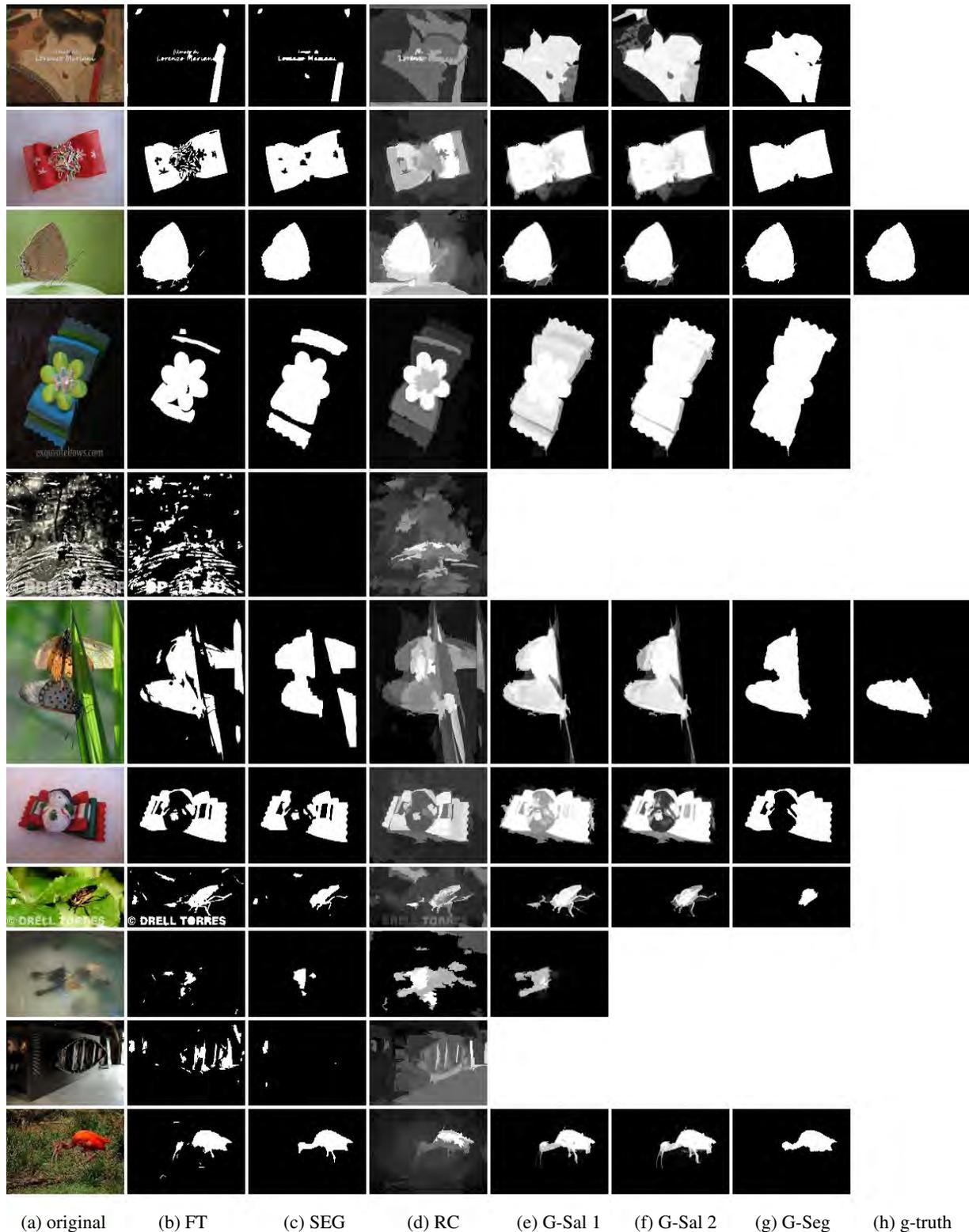
Figure 9: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
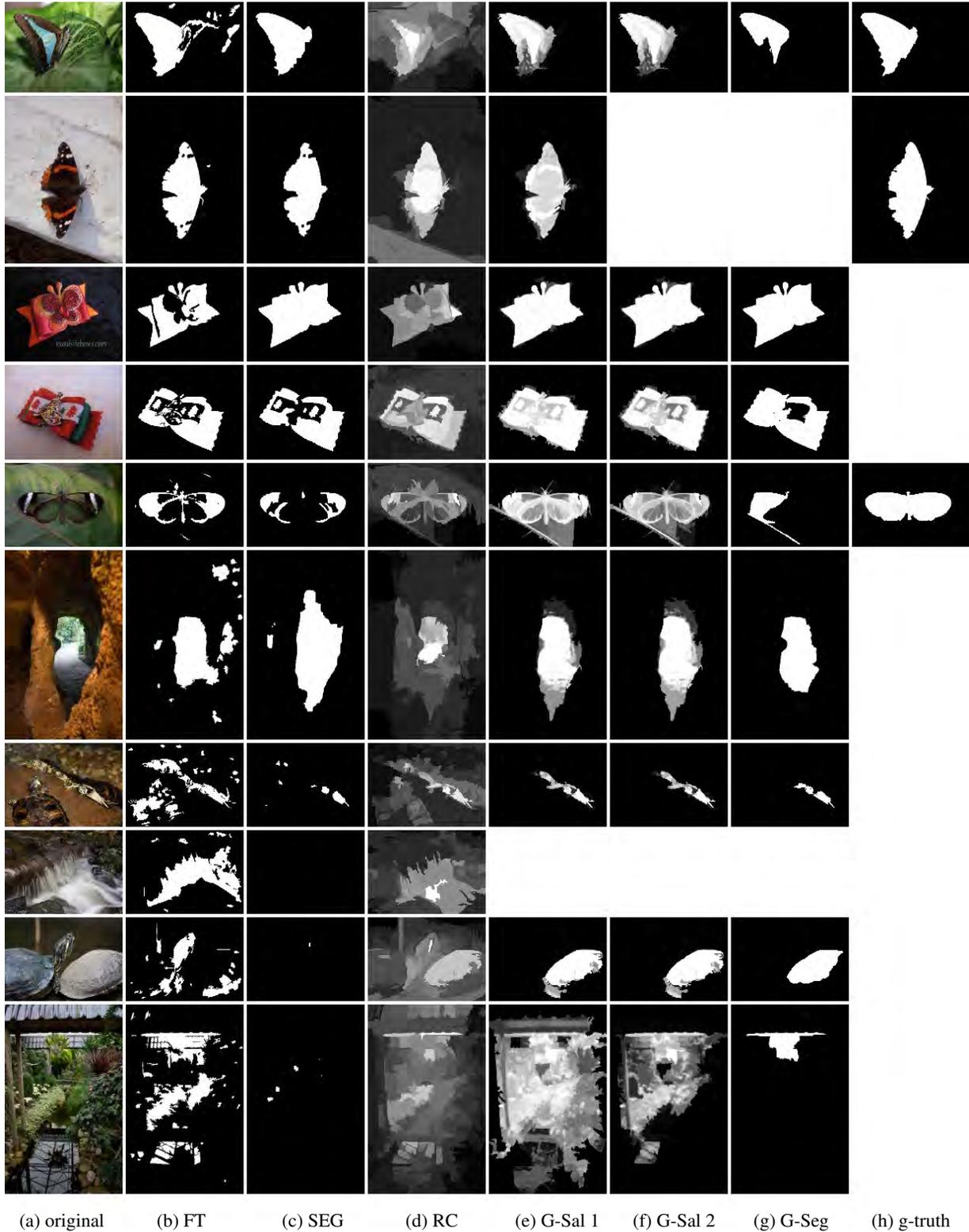
Figure 10: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
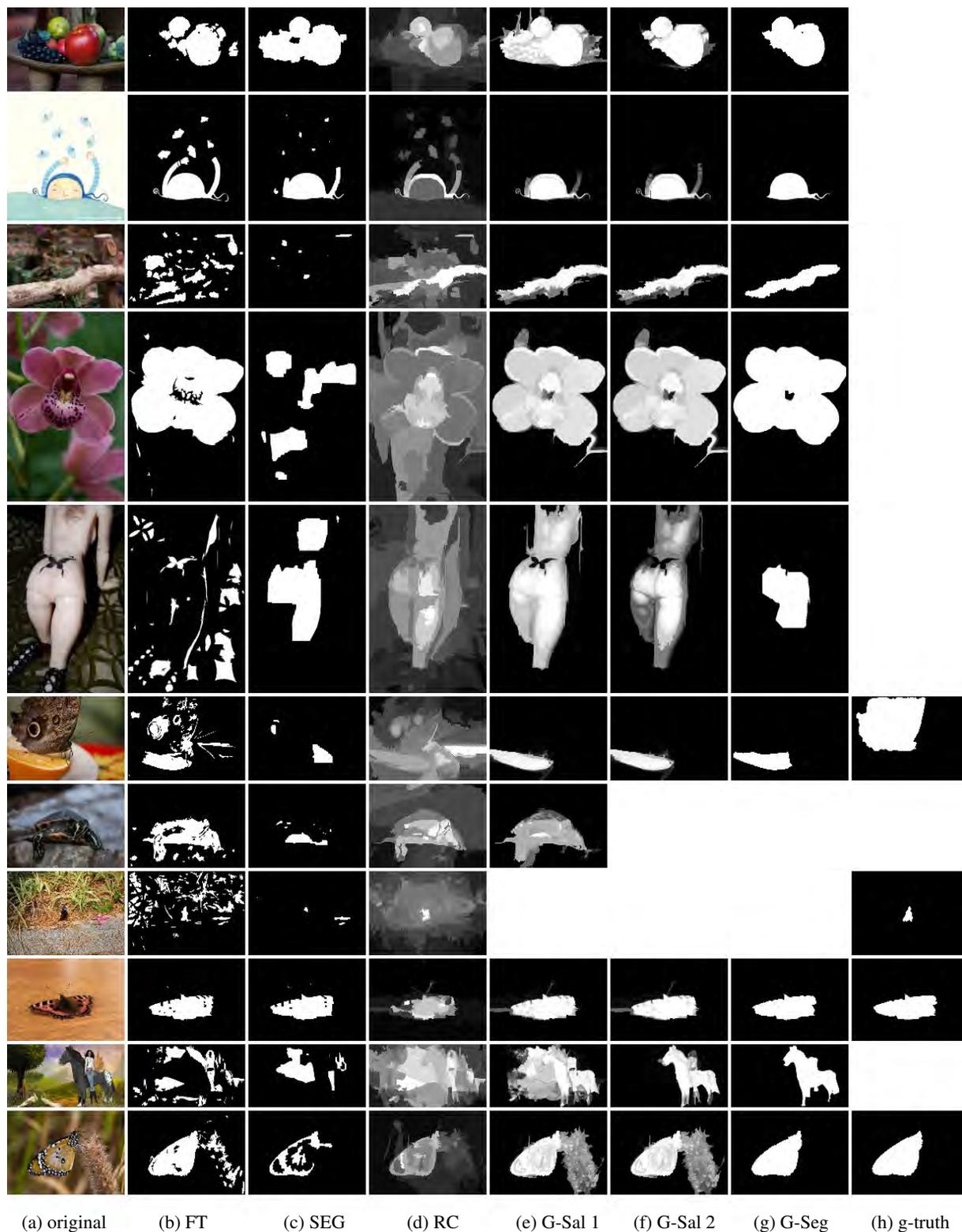
Figure 11: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
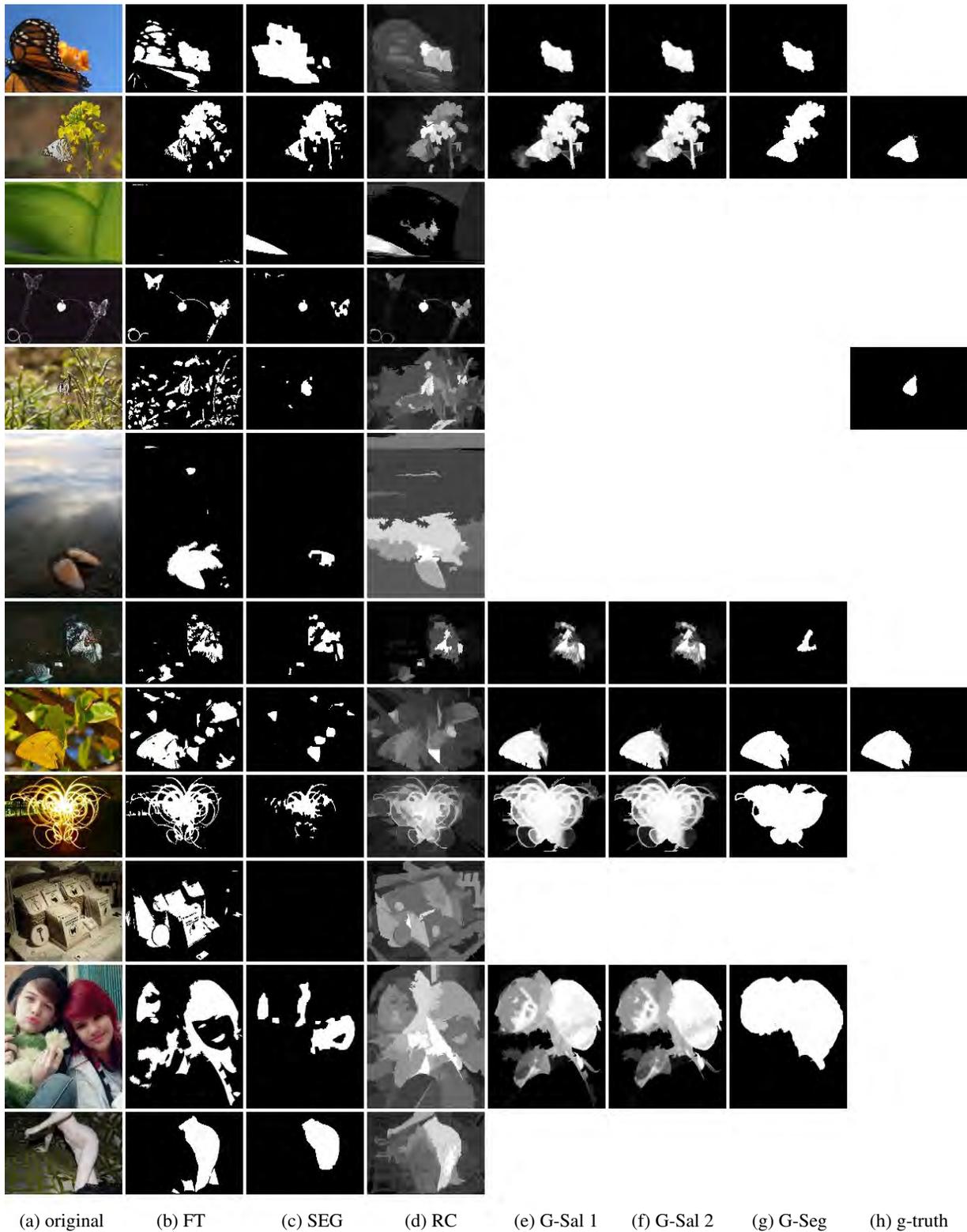
Figure 12: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
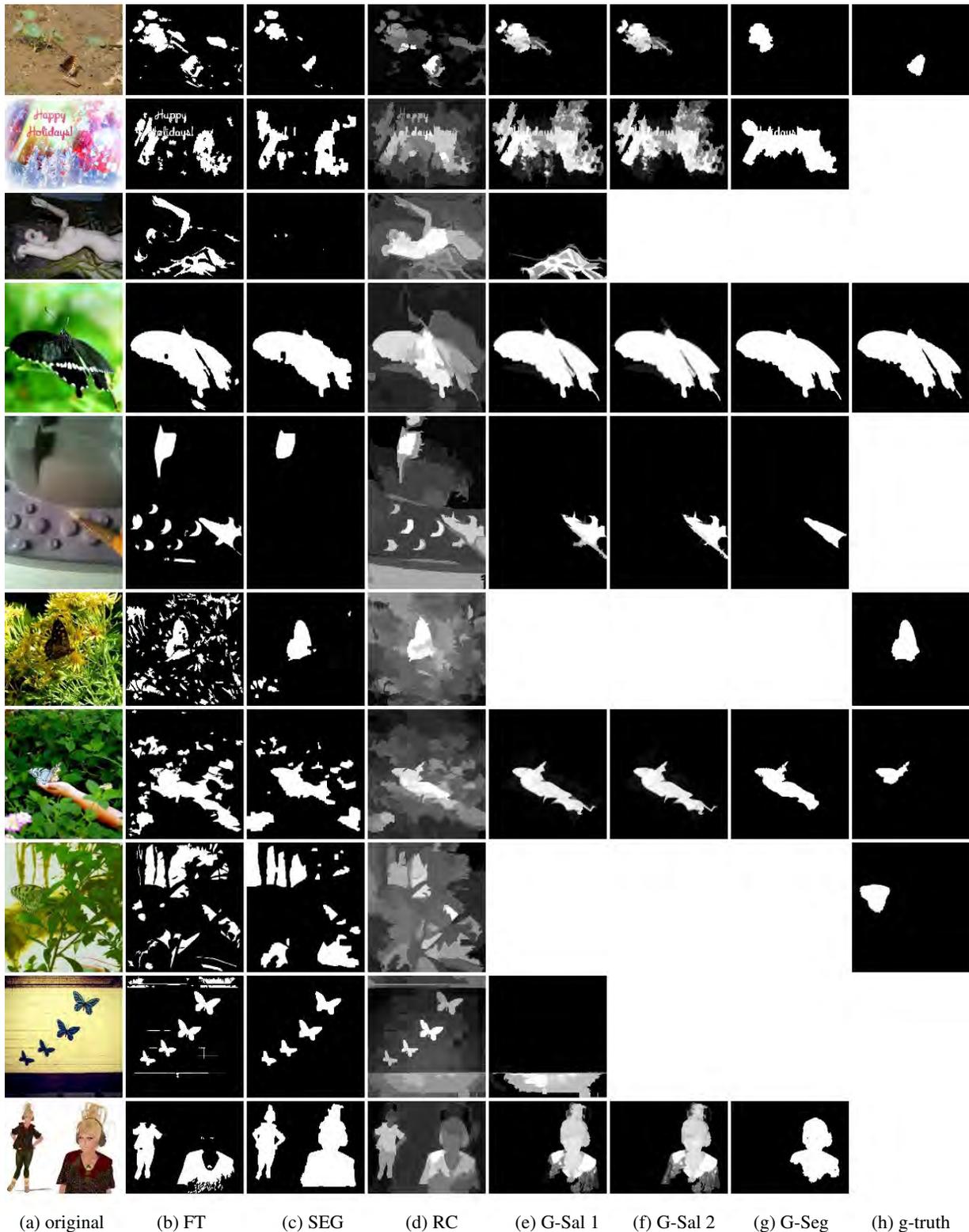
Figure 13: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
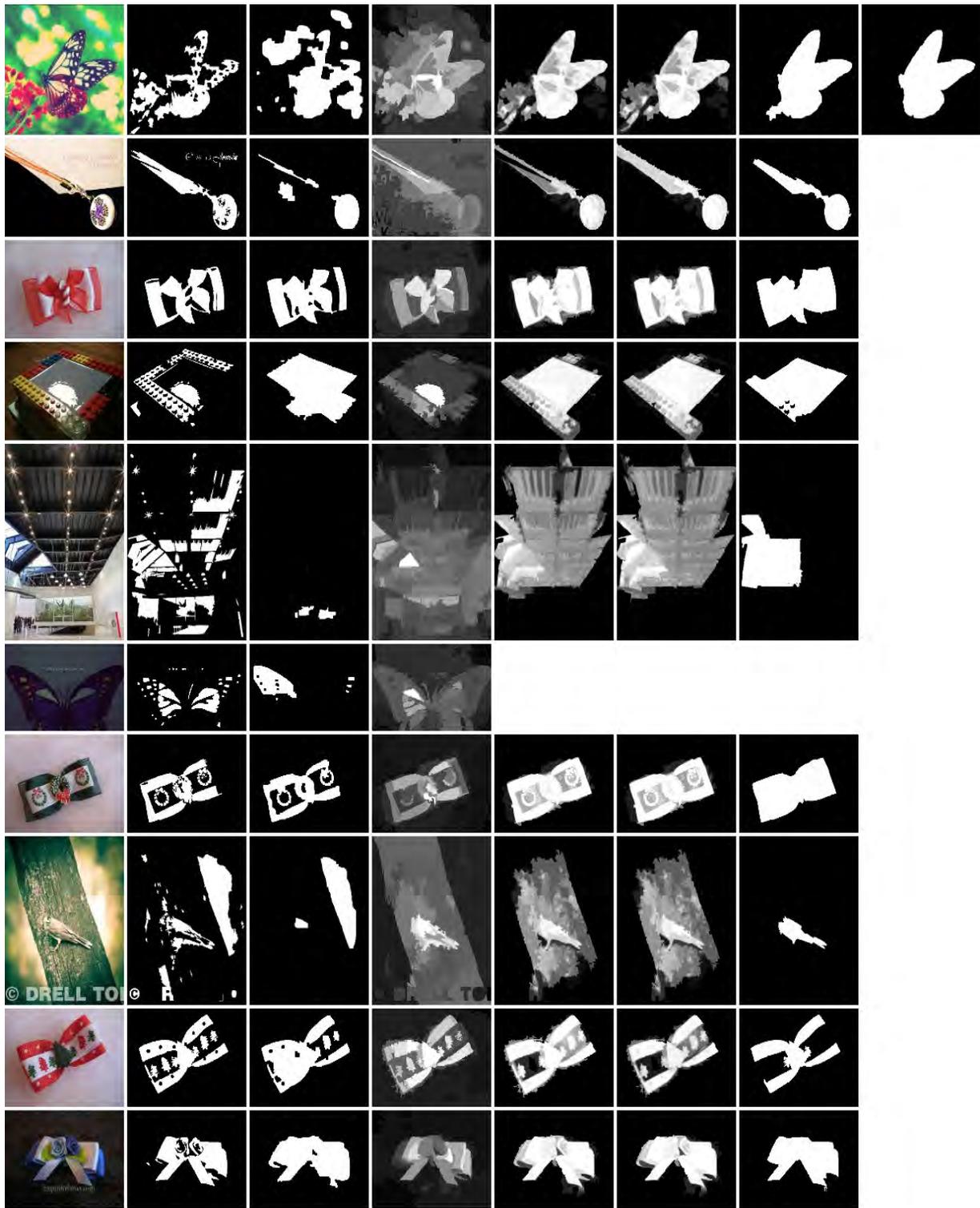
Figure 14: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 15: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1ˢᵗ iteration), (f) group saliency (2ⁿᵈ iteration), (g) group saliency segmentation, (h) g-truth*

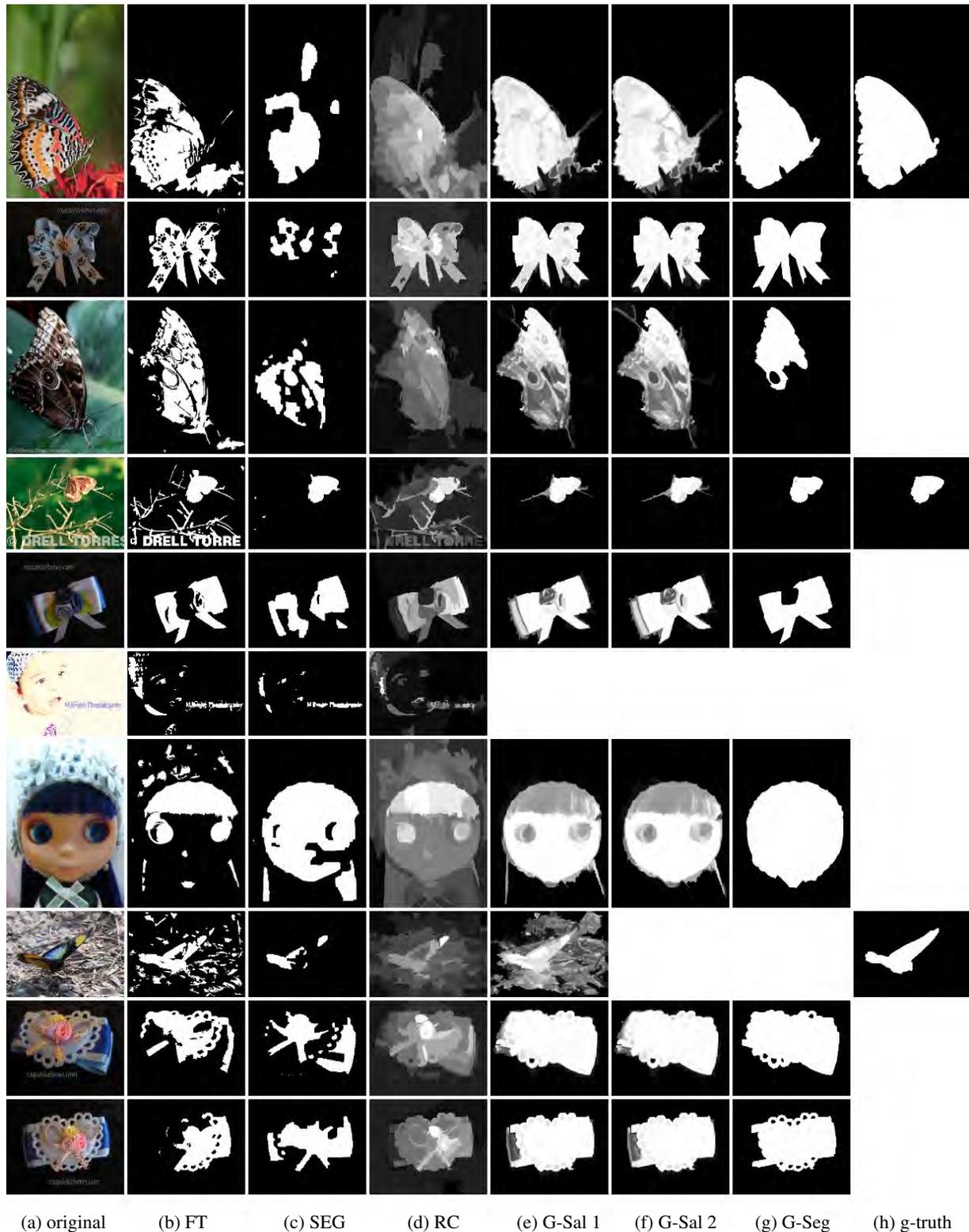| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 16: *Group saliency segmentation examples for 'butterfly': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*
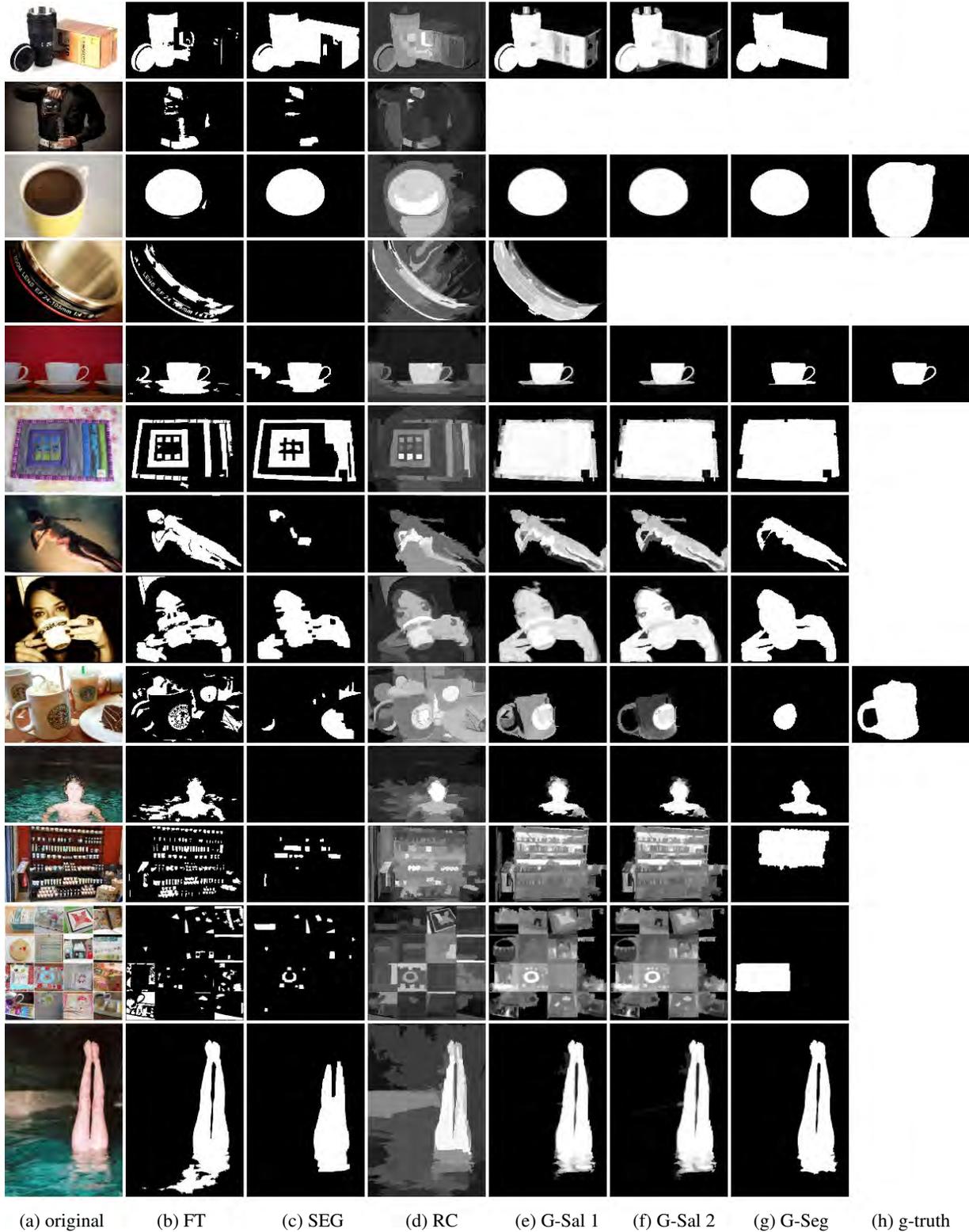
| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 17: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
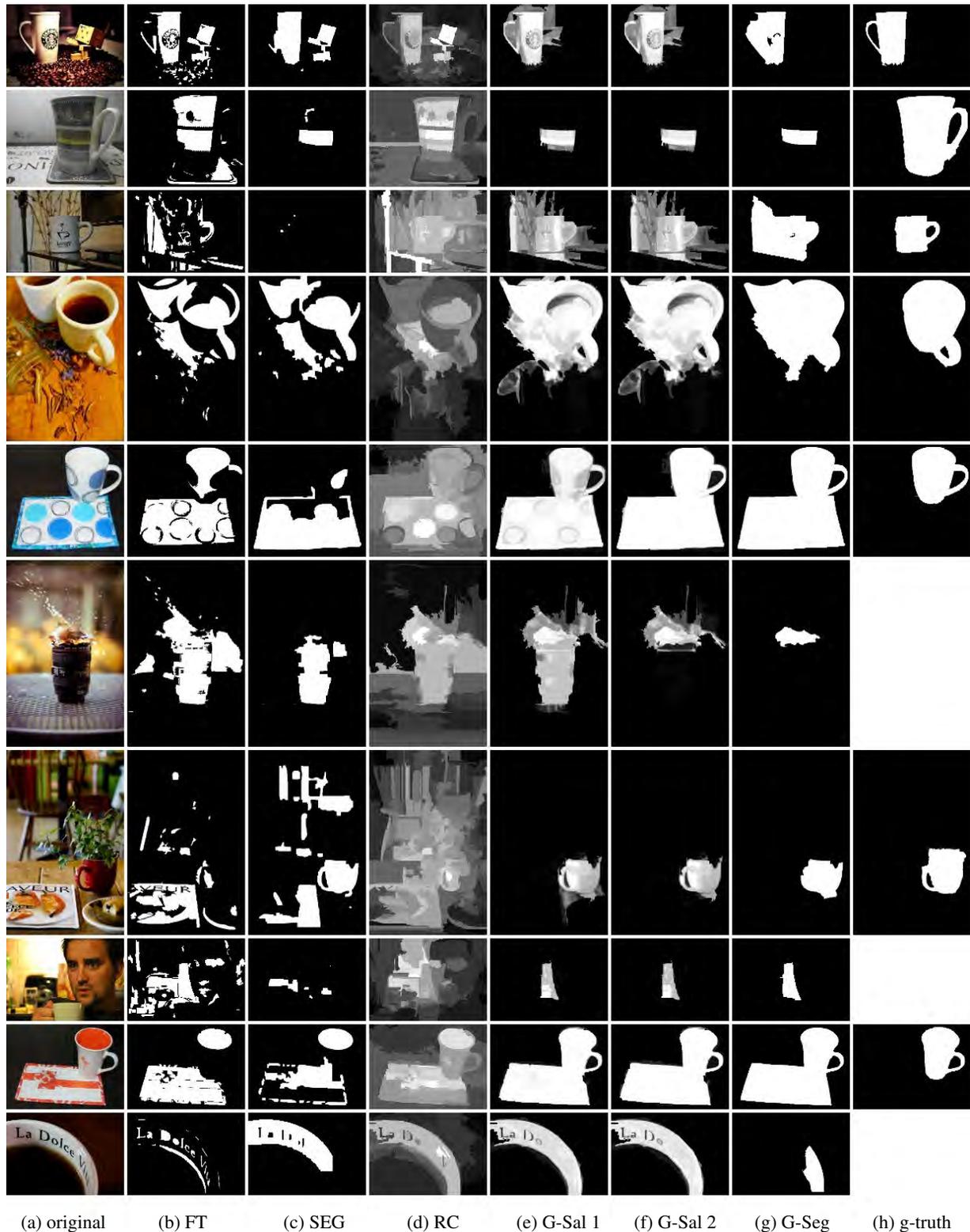
Figure 18: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

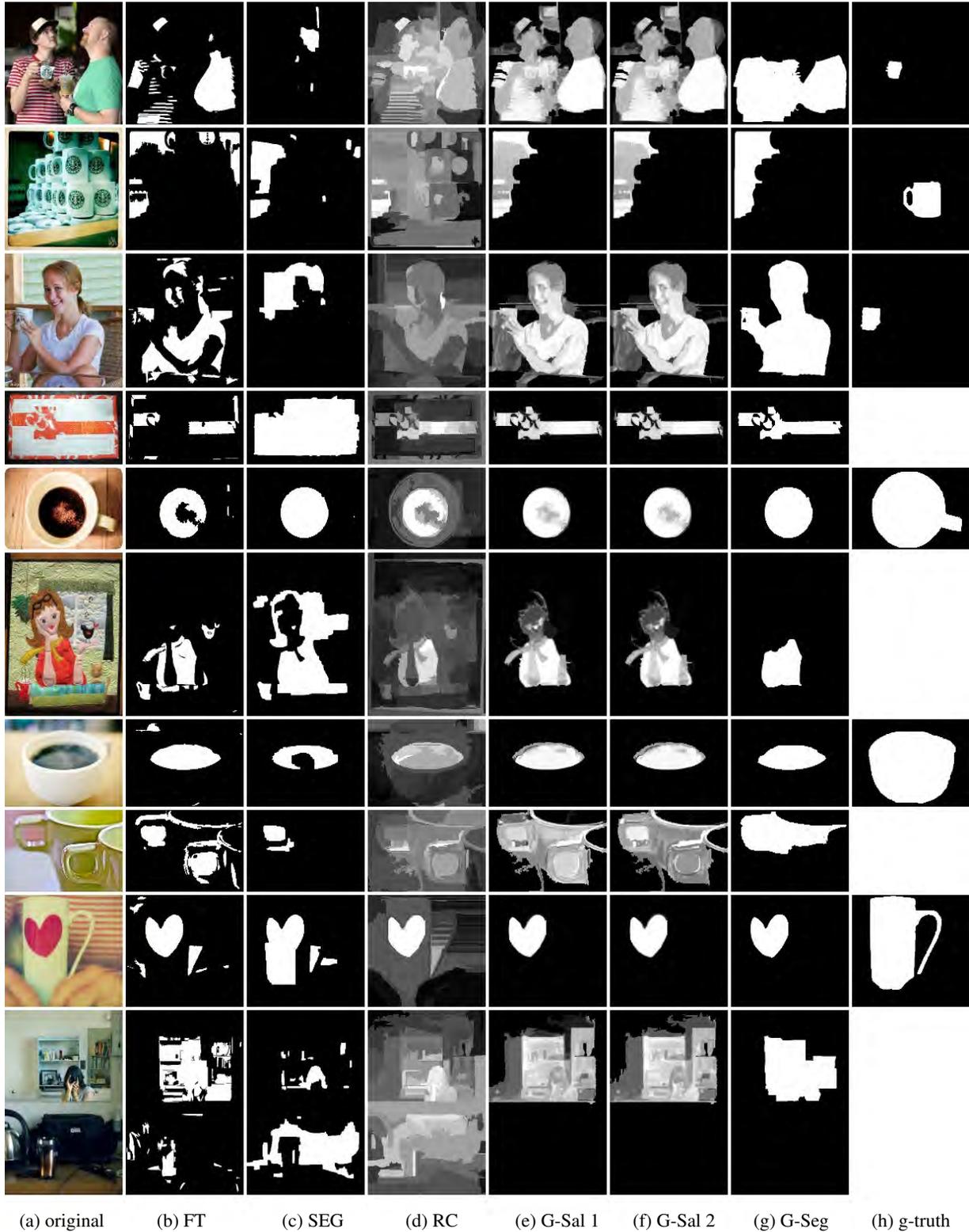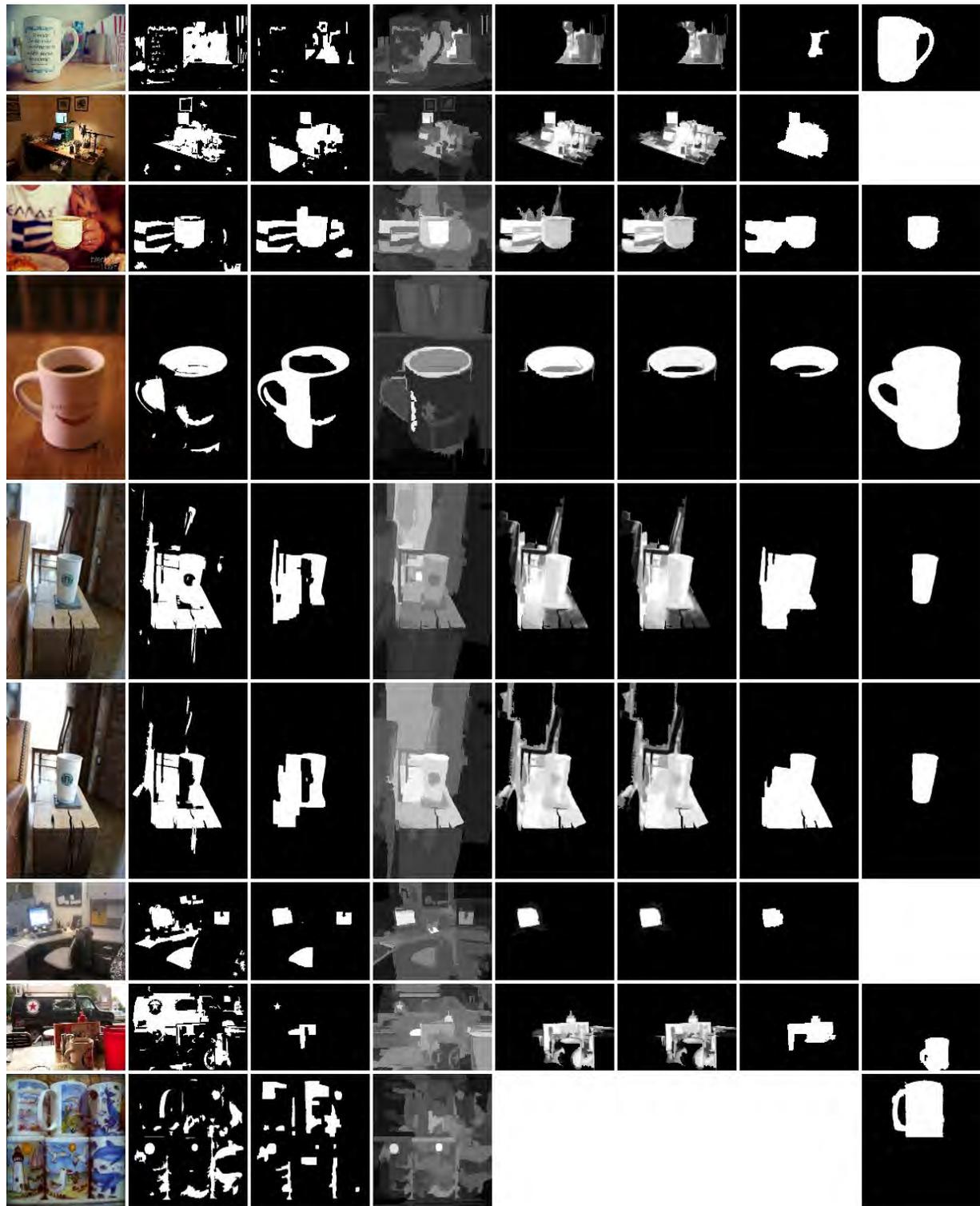| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 19: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

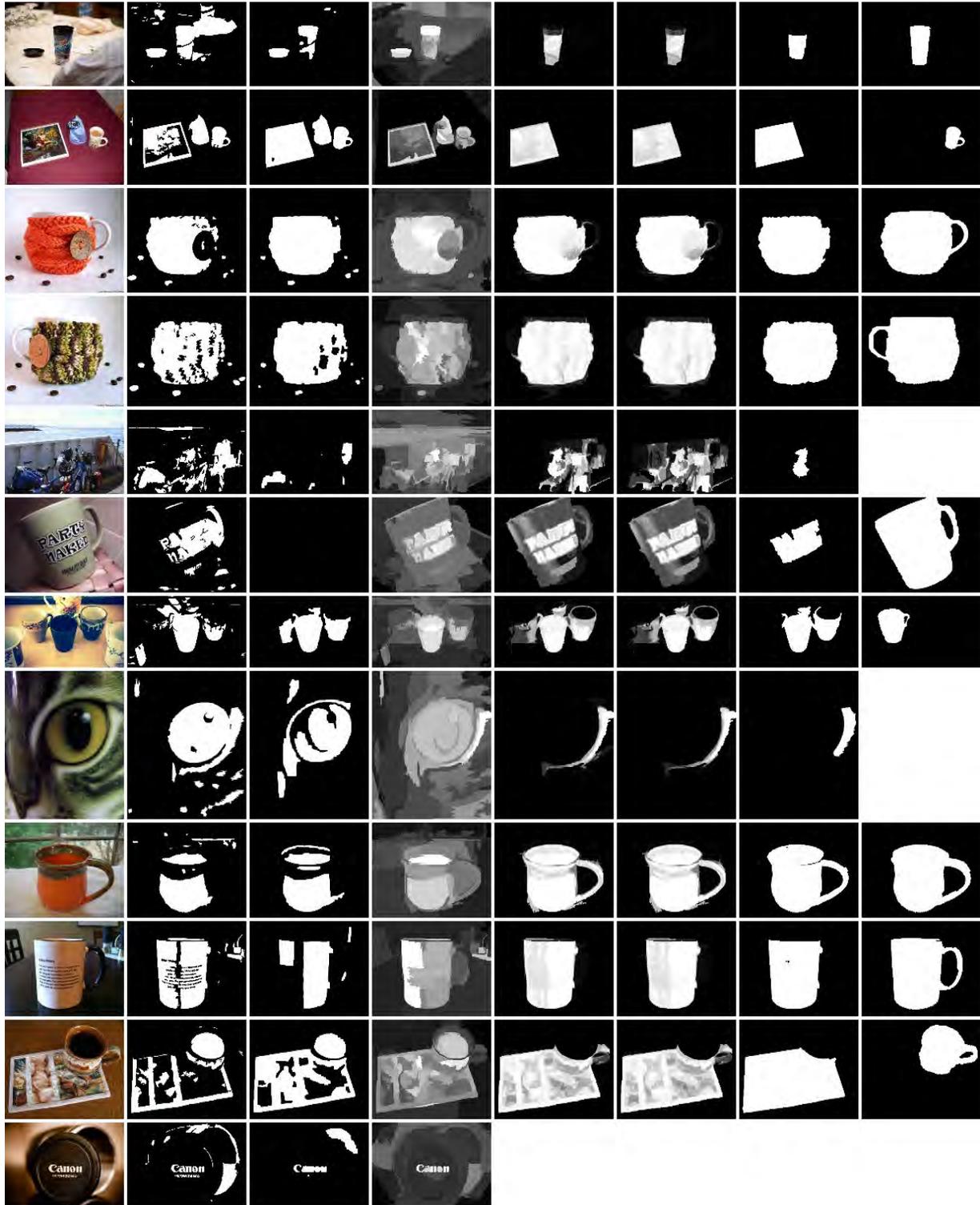| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 20: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*
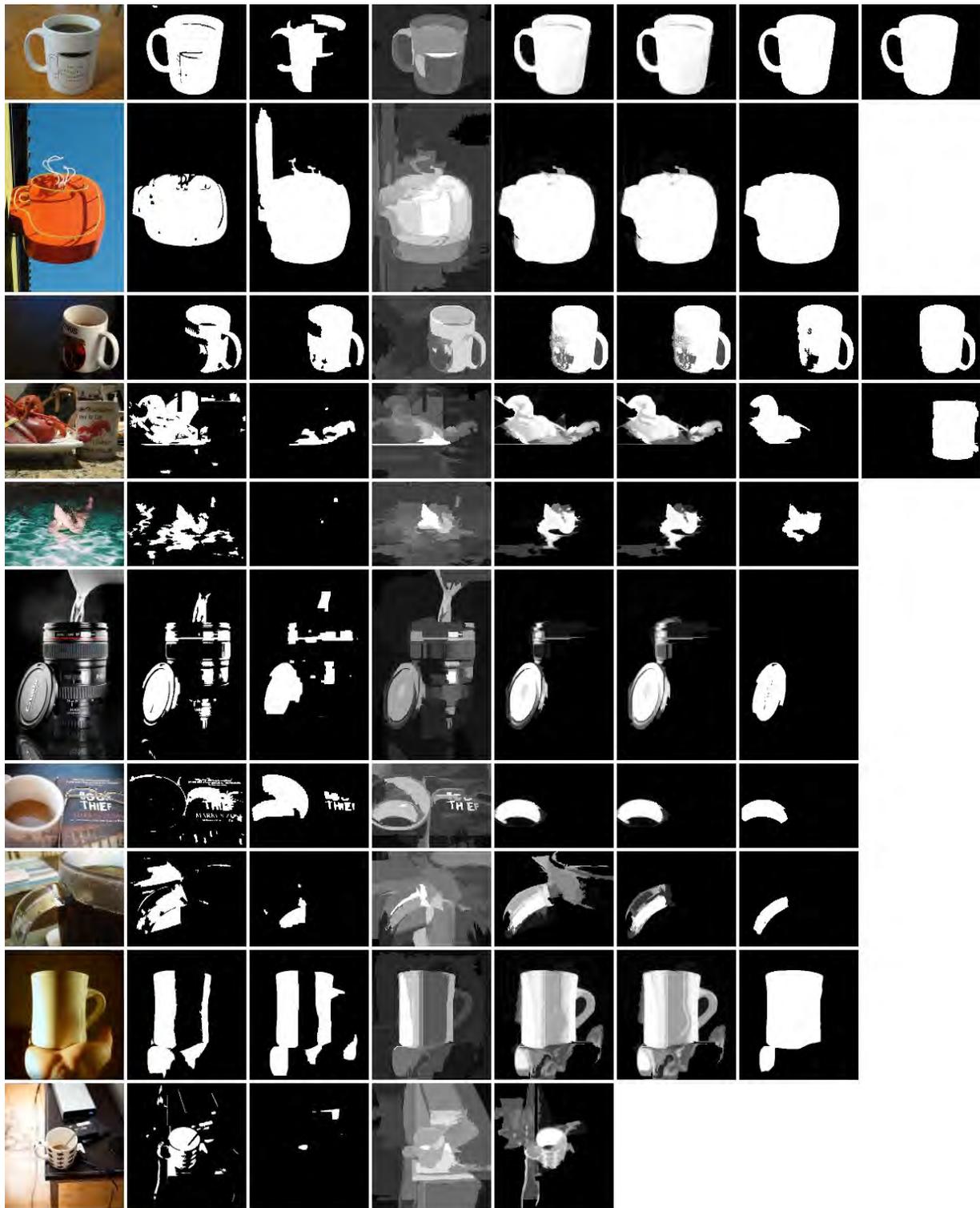
(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 21: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original	(b) FT	(c) SEG	(d) RC	(e) G-Sal 1	(f) G-Sal 2	(g) G-Seg	(h) g-truth

Figure 22: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original (b) FT (c) SEG (d) RC (e) G-Sal 1 (f) G-Sal 2 (g) G-Seg (h) g-truth

Figure 23: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 24: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1ˢᵗ iteration), (f) group saliency (2ⁿᵈ iteration), (g) group saliency segmentation, (h) g-truth*
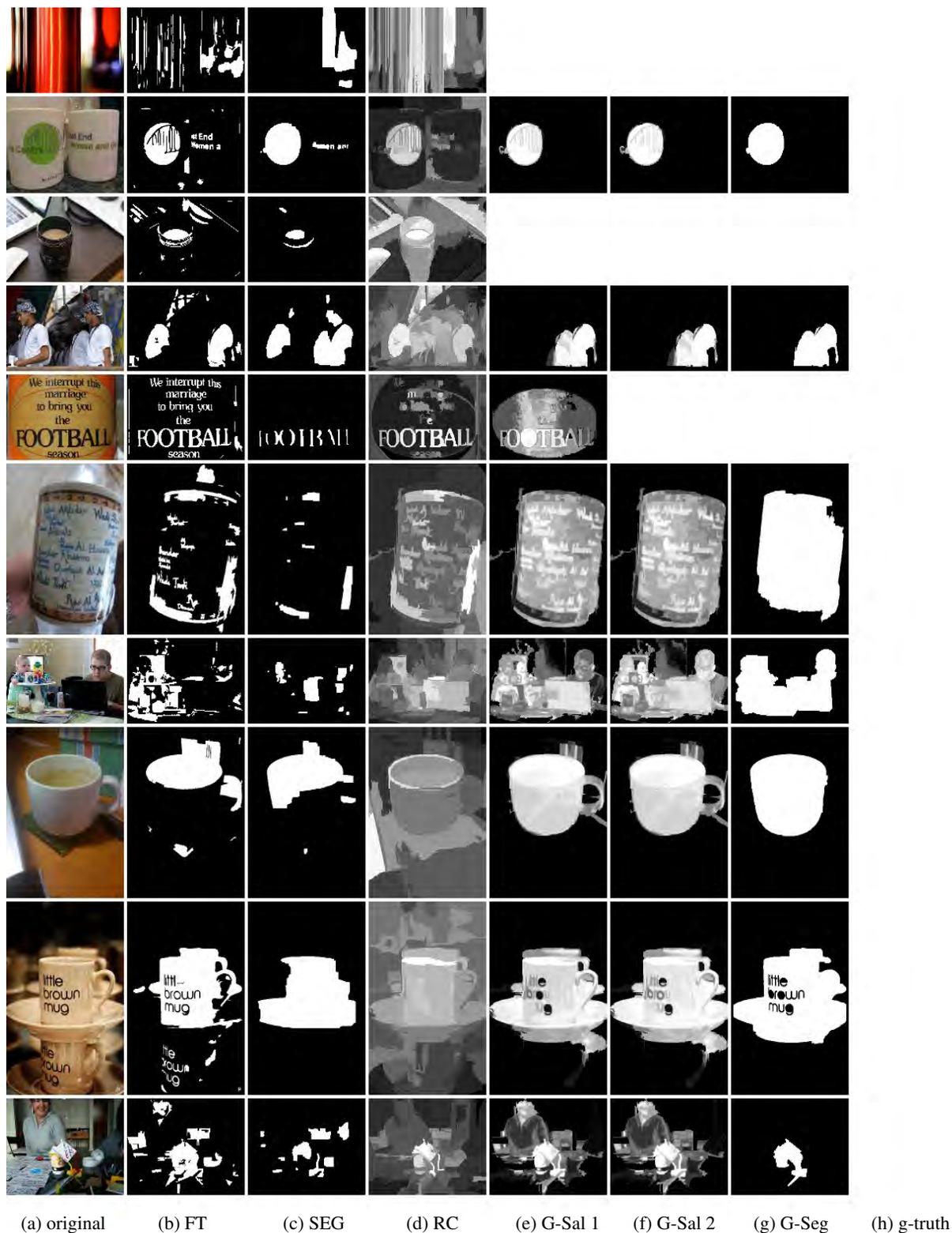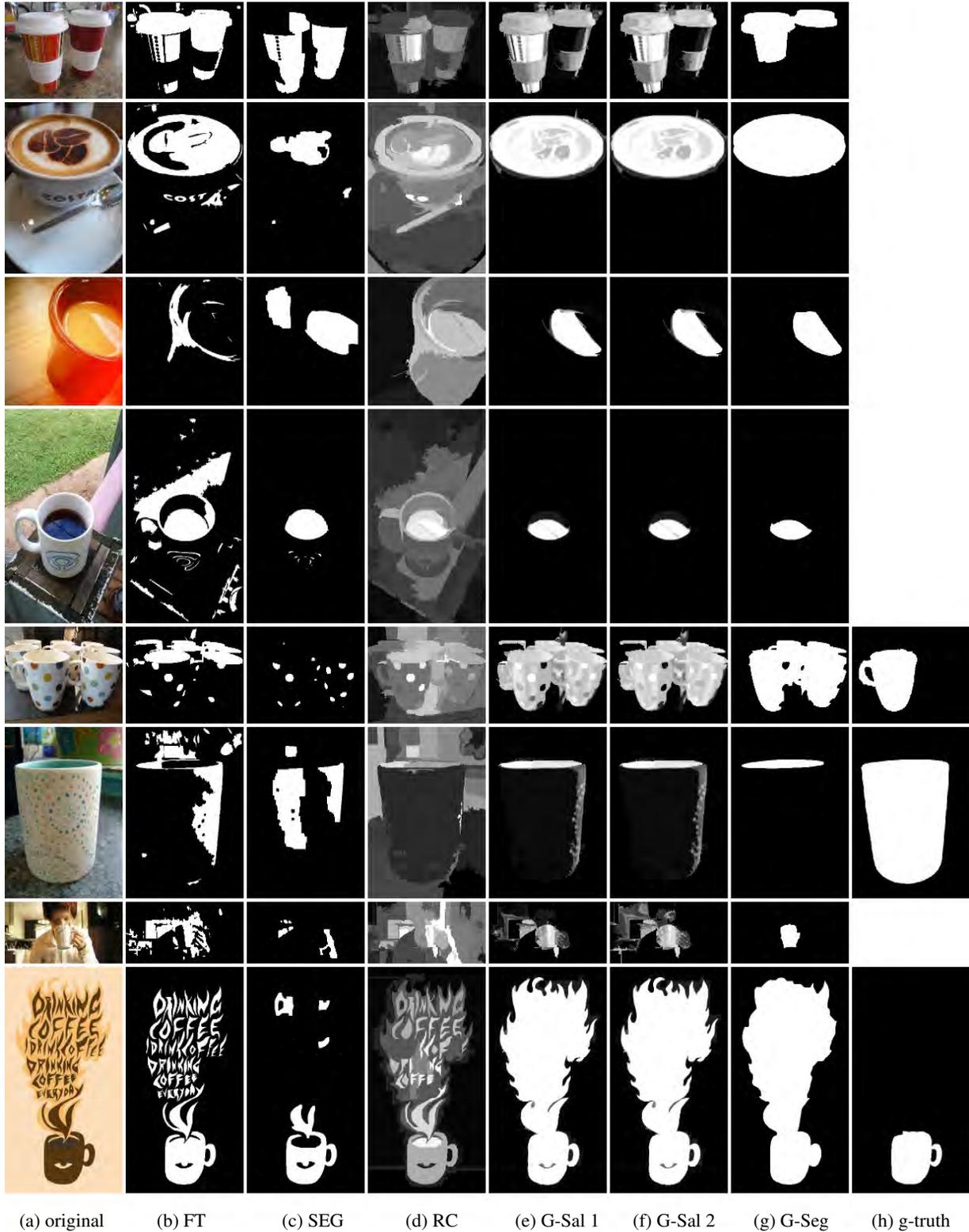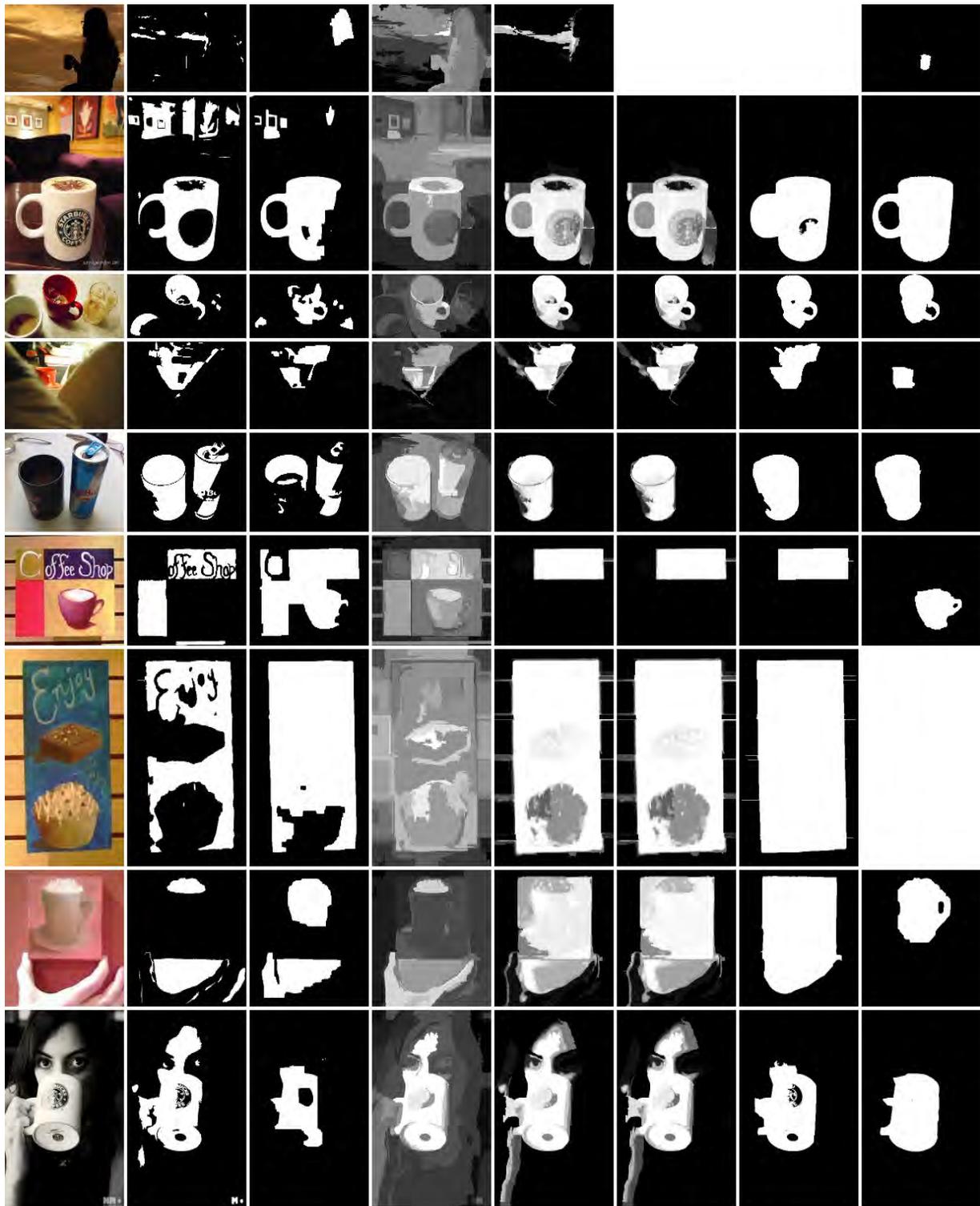
(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 25: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 26: *Group saliency segmentation examples for 'coffee mug': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

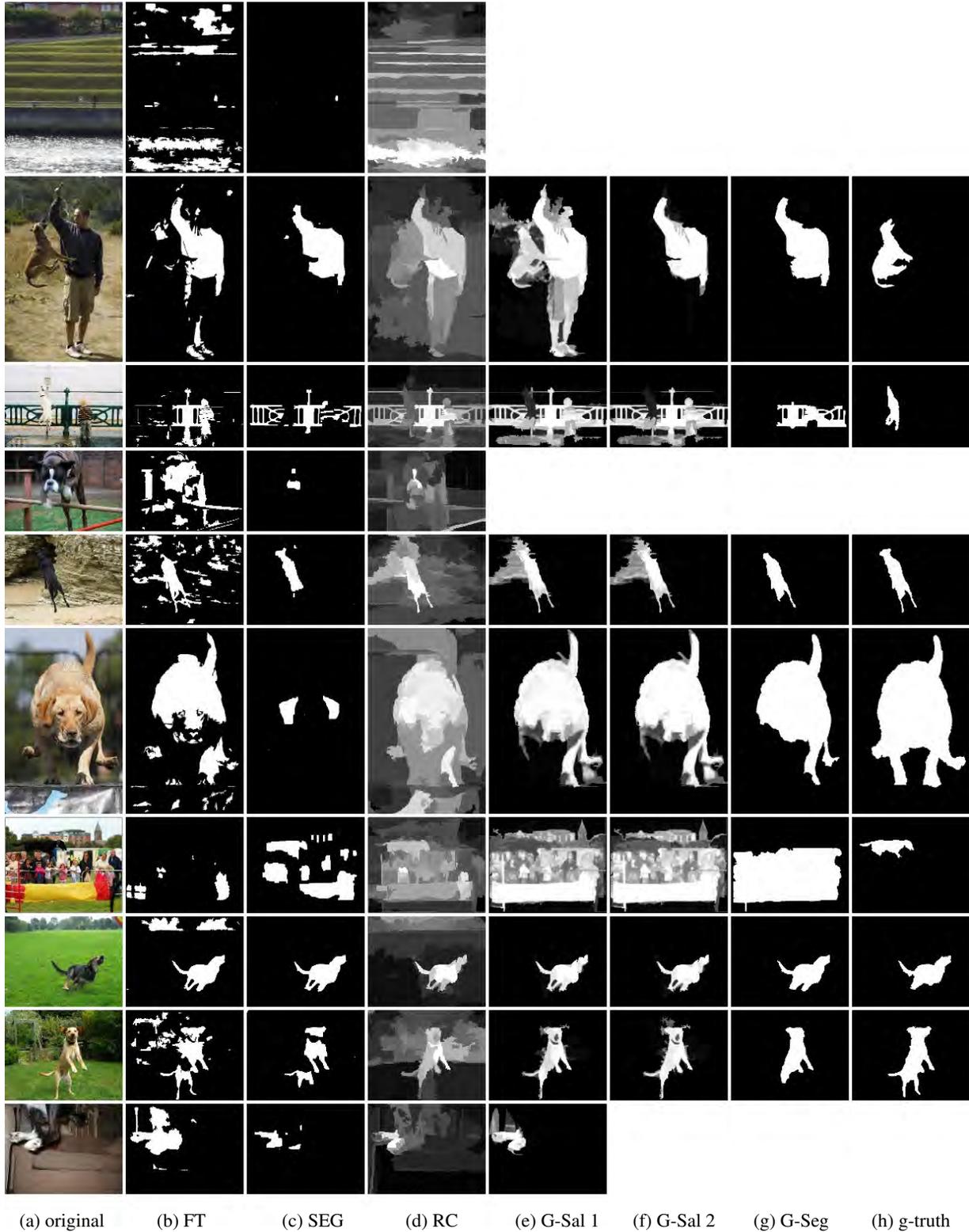| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 27: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 28: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

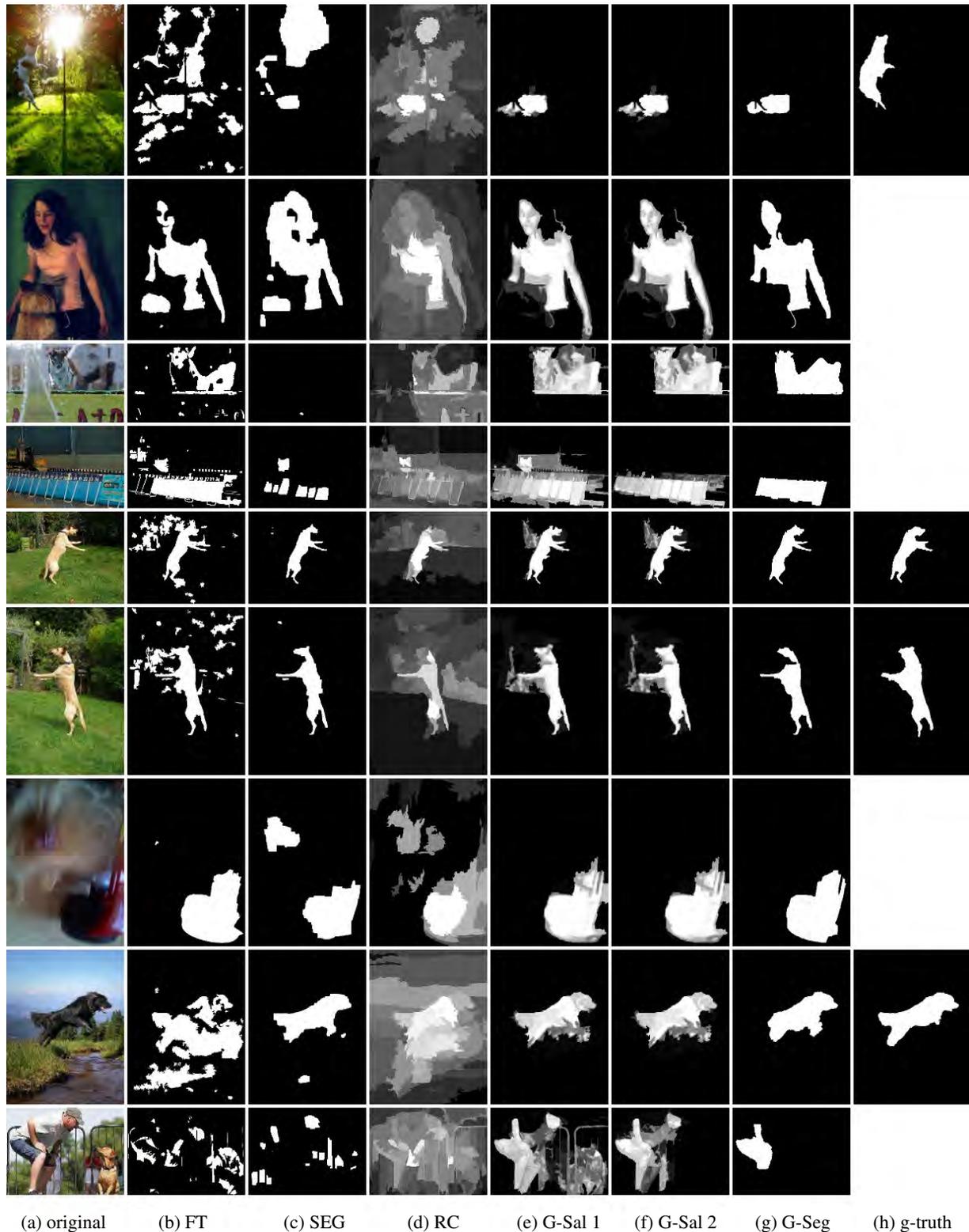| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 29: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

　(a) original　　　(b) FT　　　(c) SEG　　　(d) RC　　　(e) G-Sal 1　　　(f) G-Sal 2　　　(g) G-Seg　　　(h) g-truth
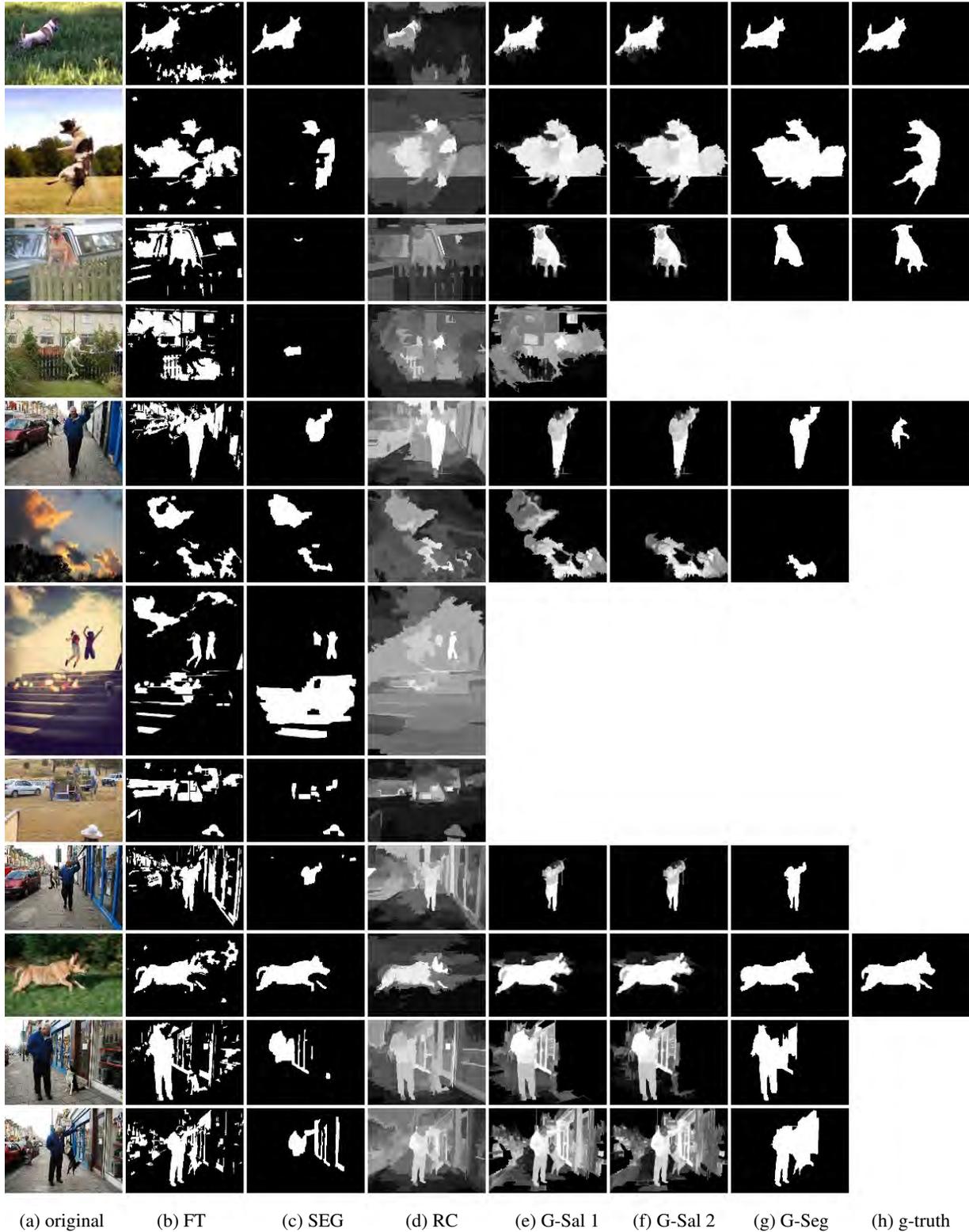
Figure 30: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
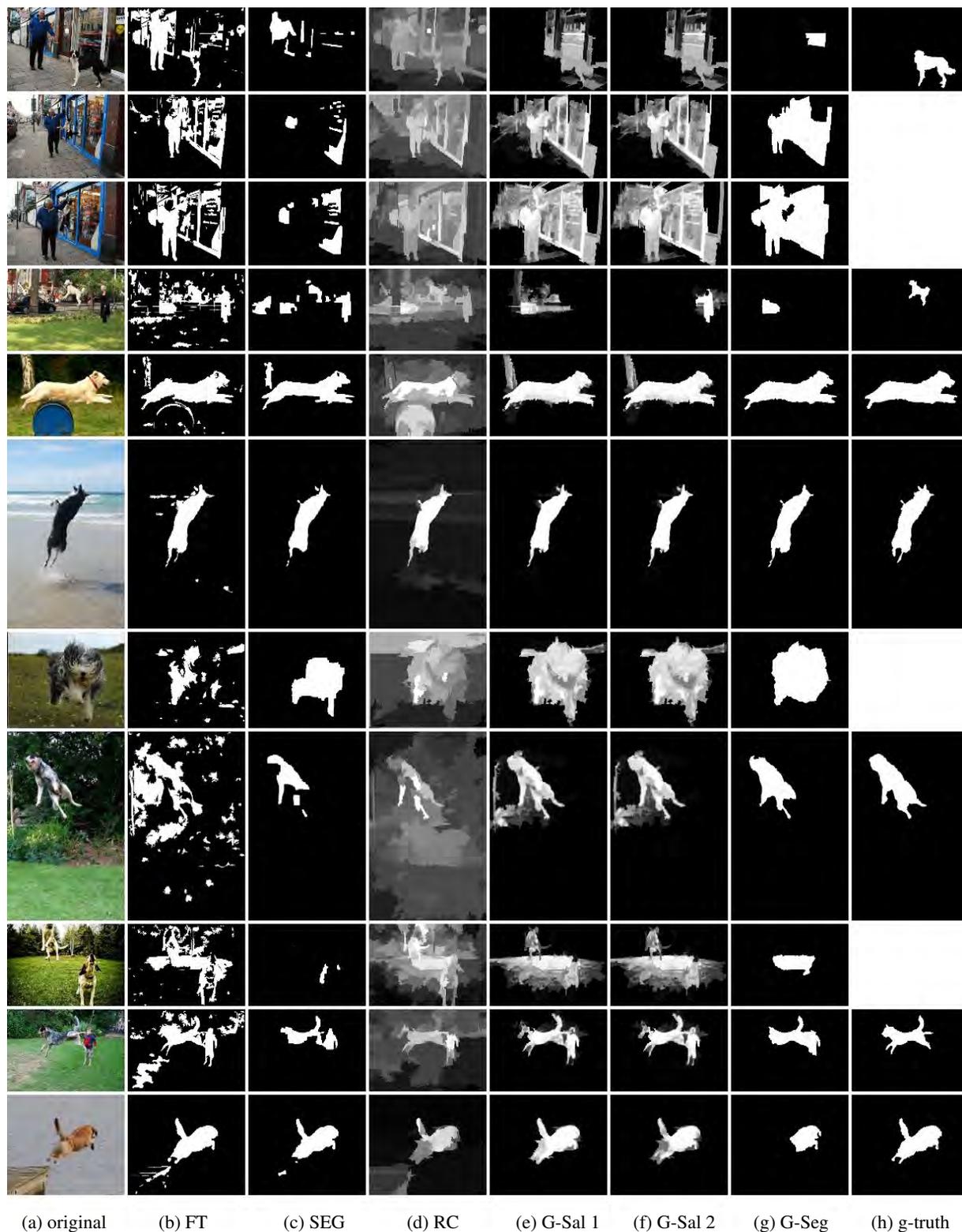
Figure 31: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*
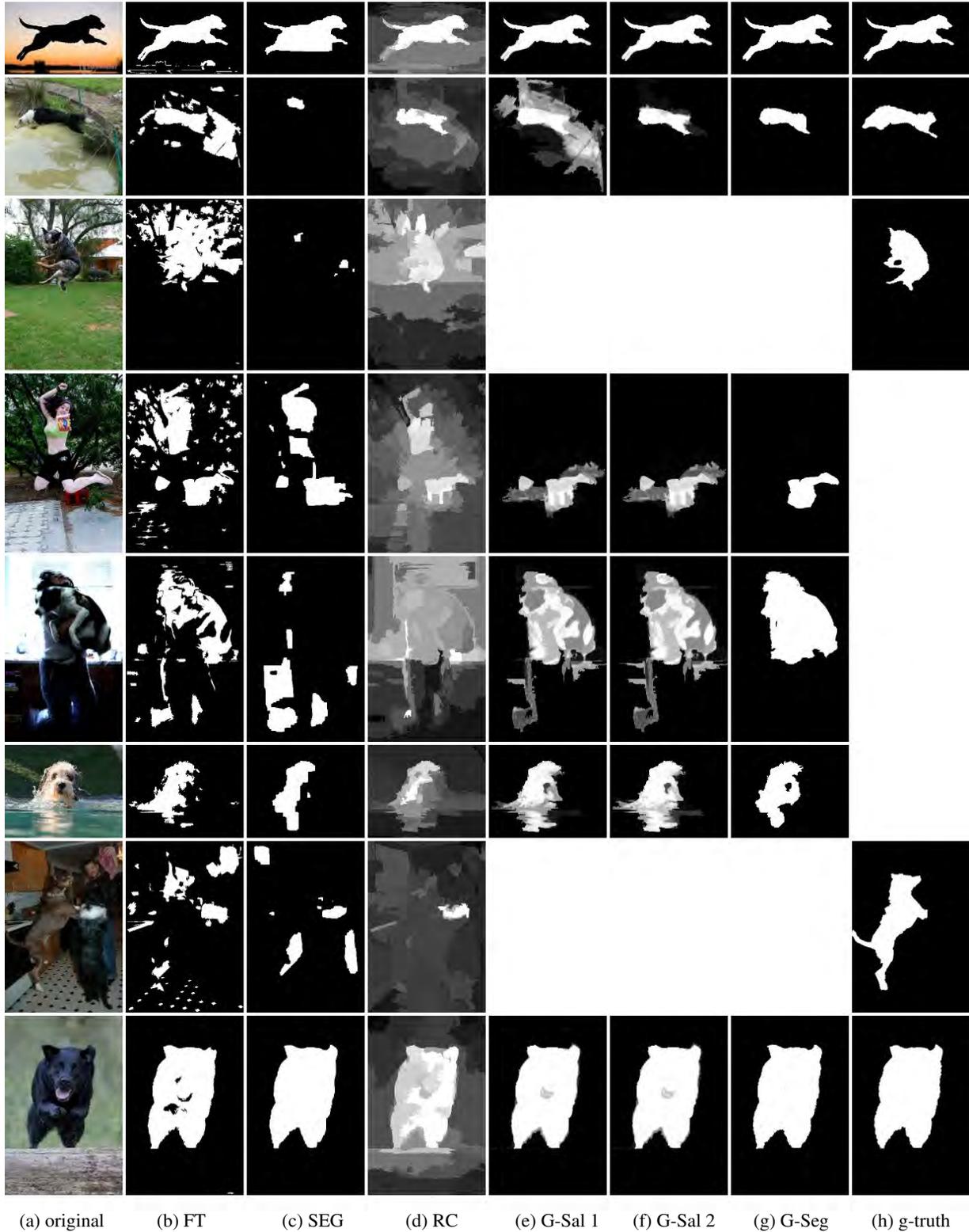
(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 32: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 33: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
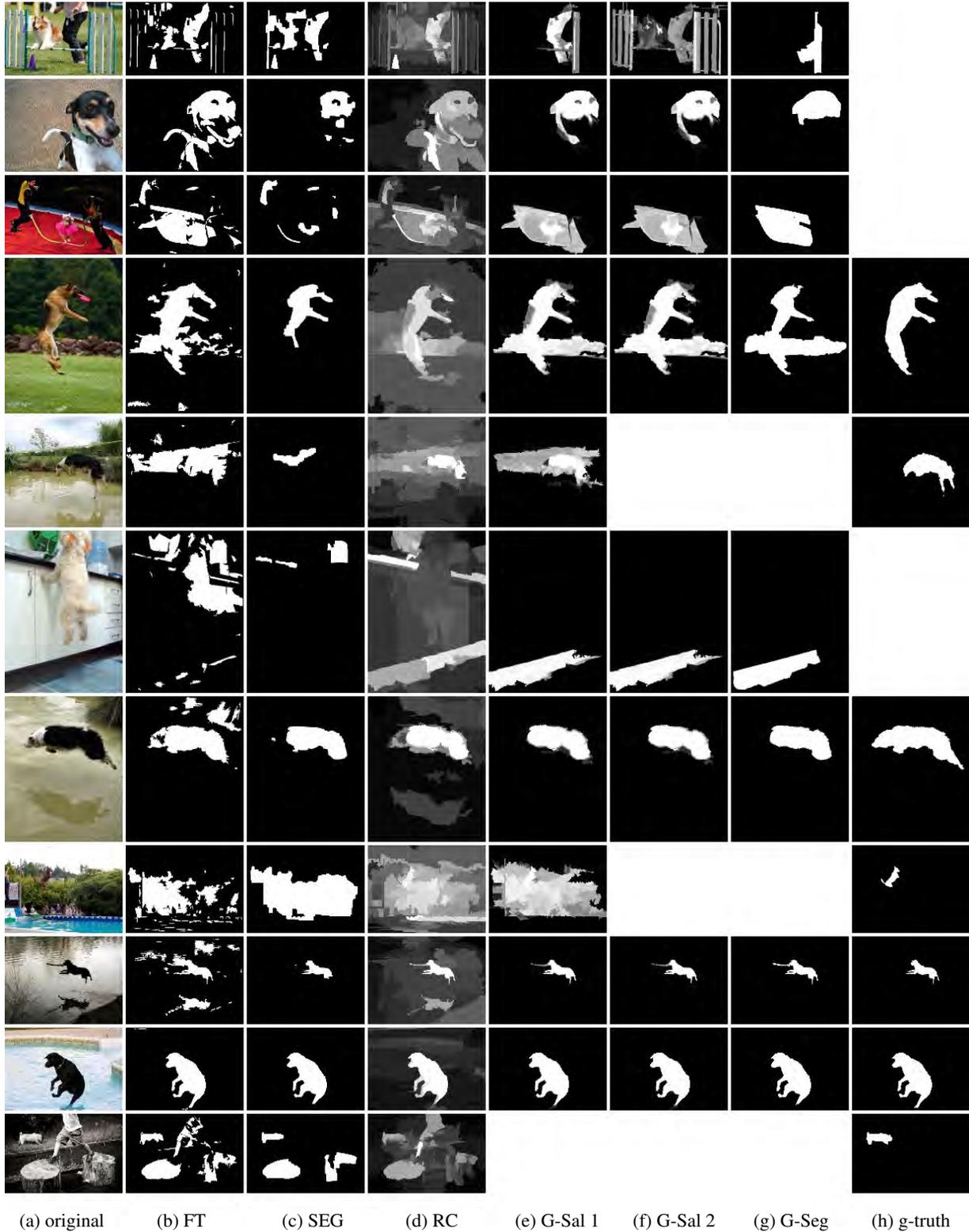
Figure 34: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 35: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
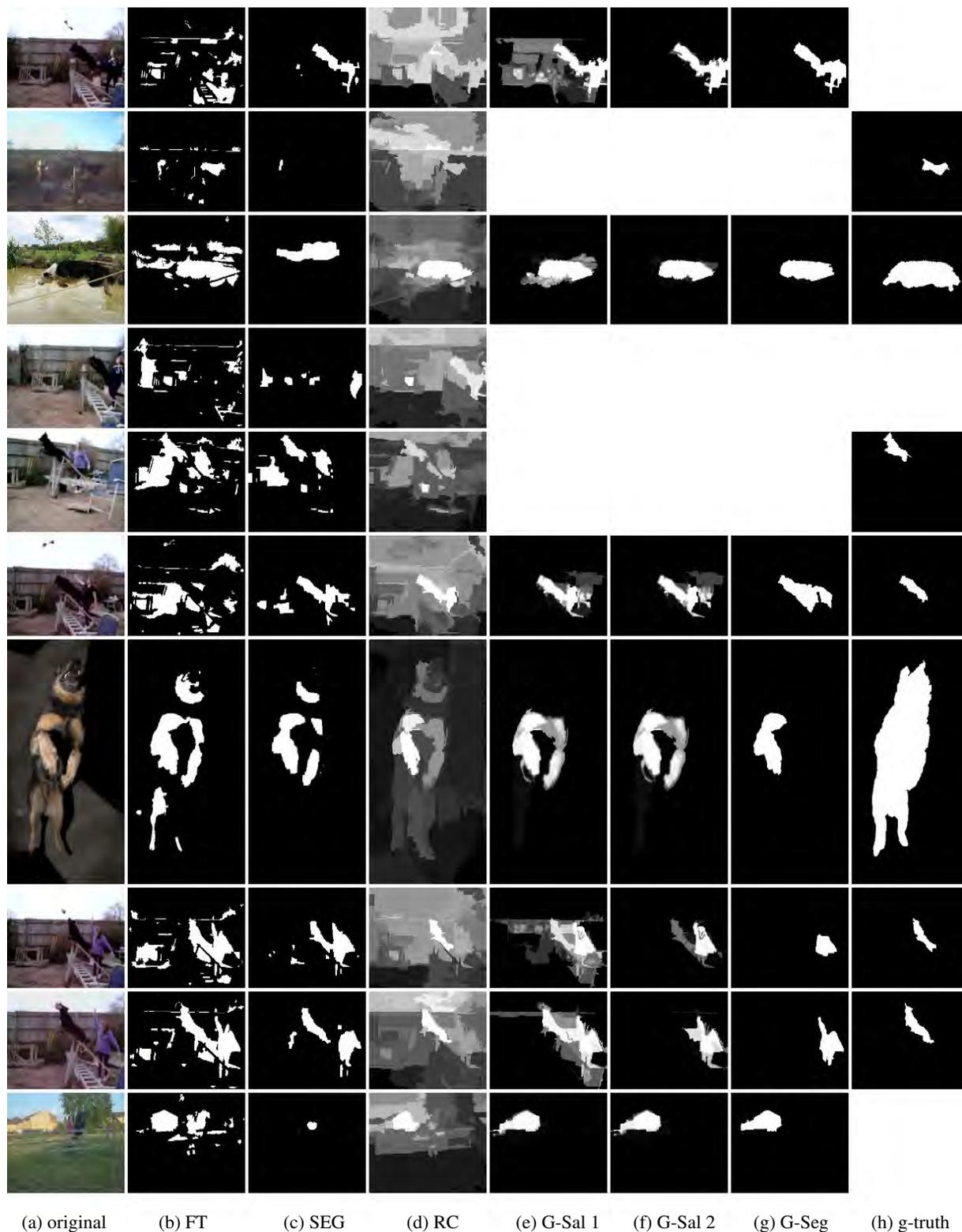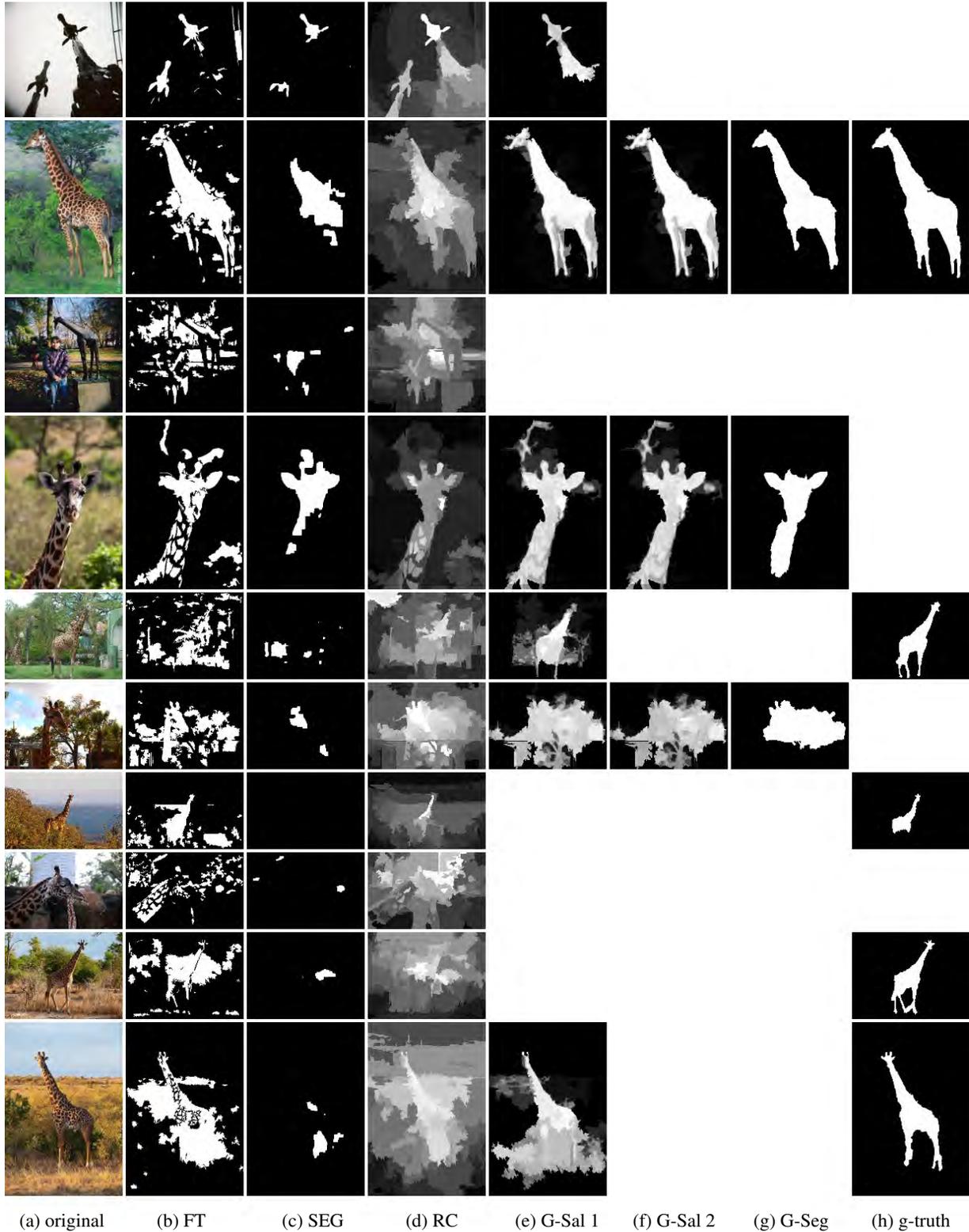
Figure 36: *Group saliency segmentation examples for 'dog jump': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 37: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

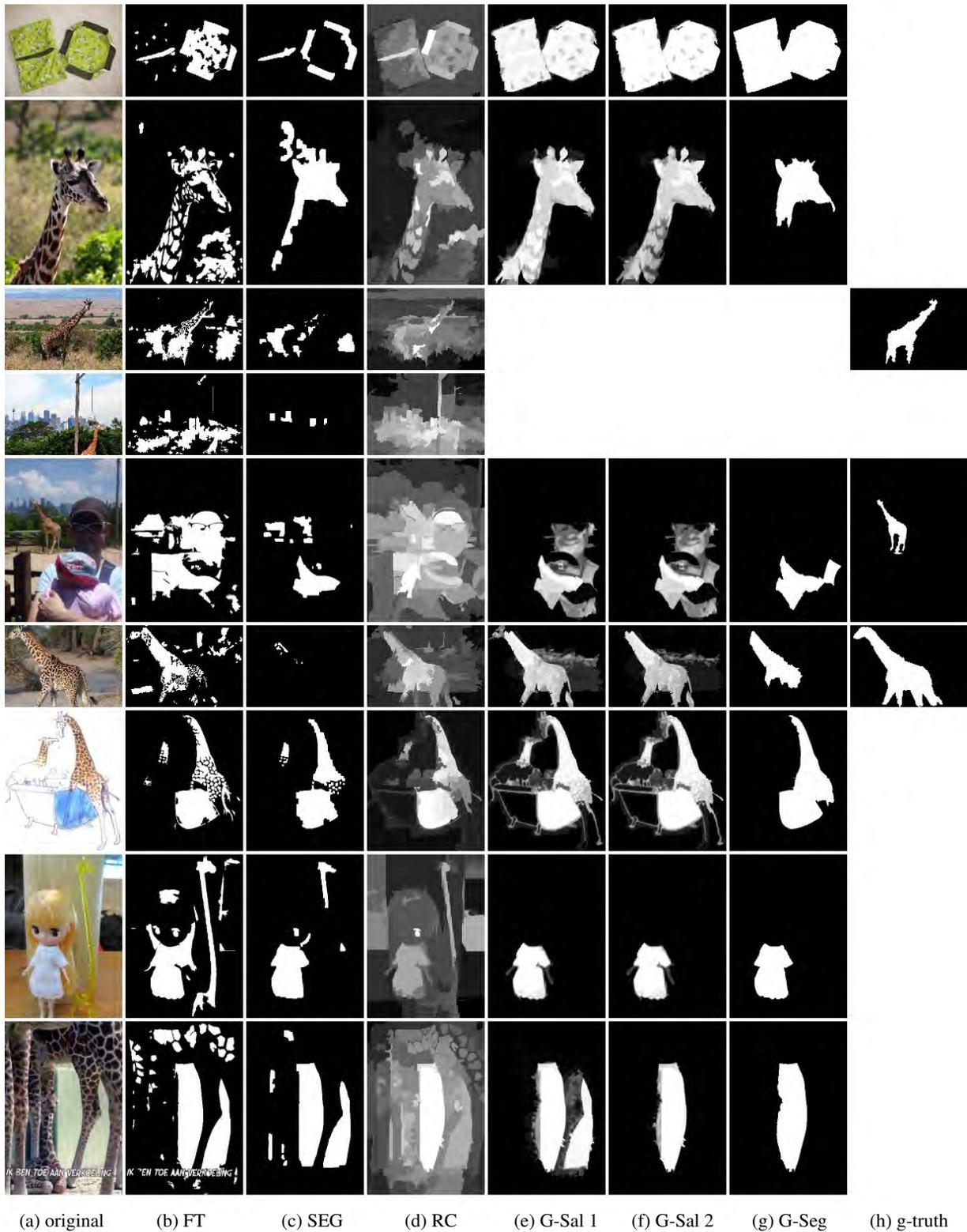| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 38: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 39: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 40: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
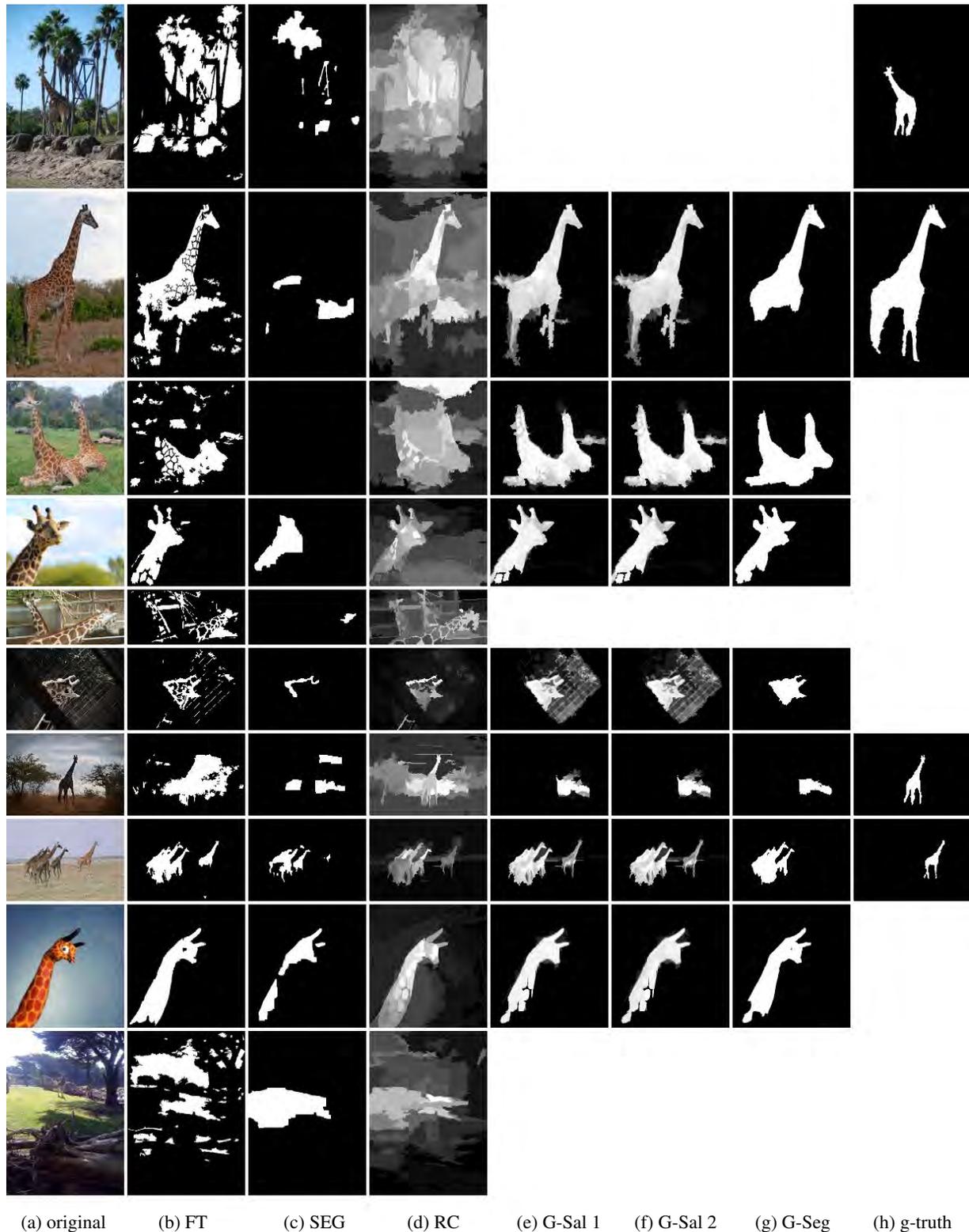
Figure 41: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*
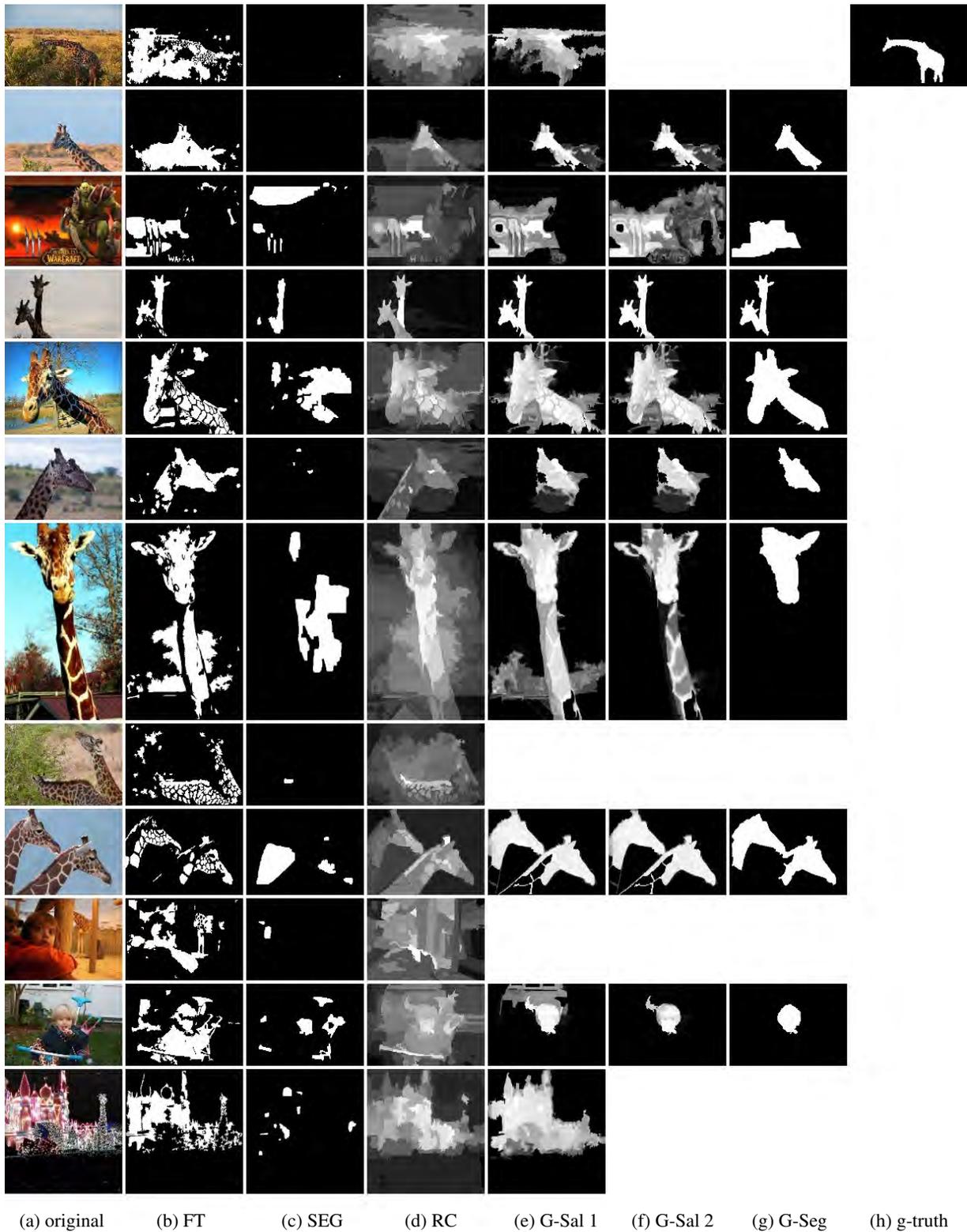
(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 42: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 43: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

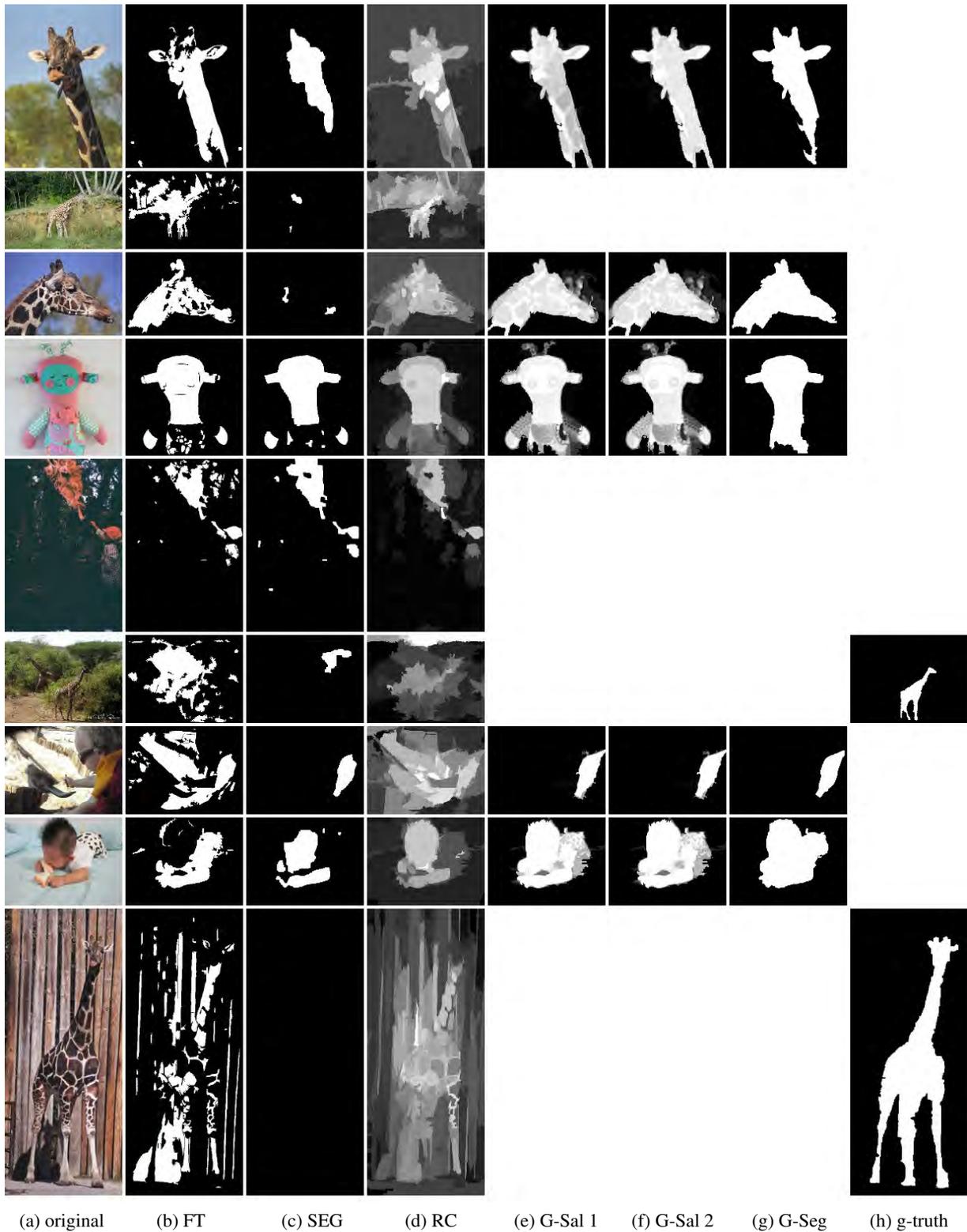| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 44: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
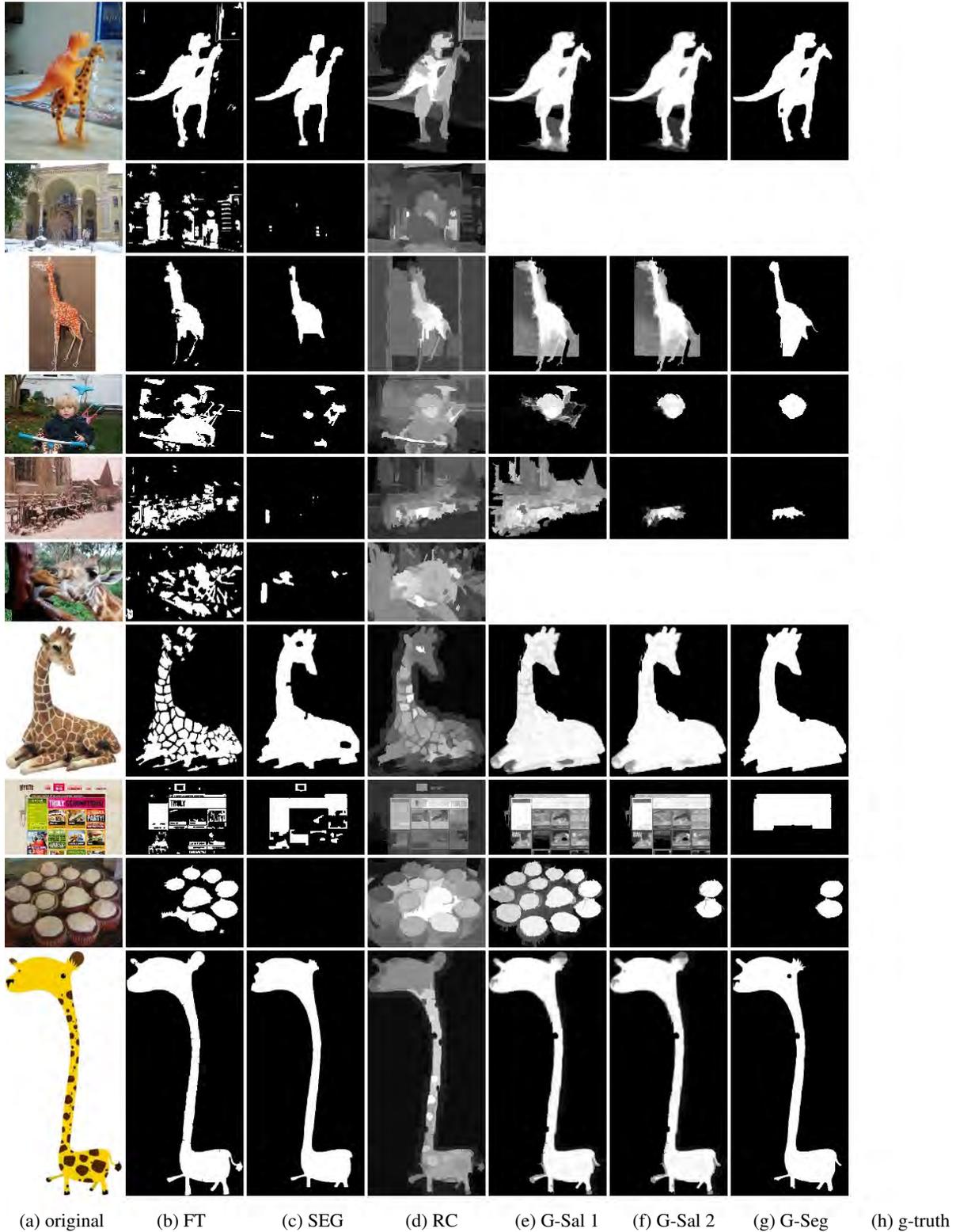
Figure 45: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

   (a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
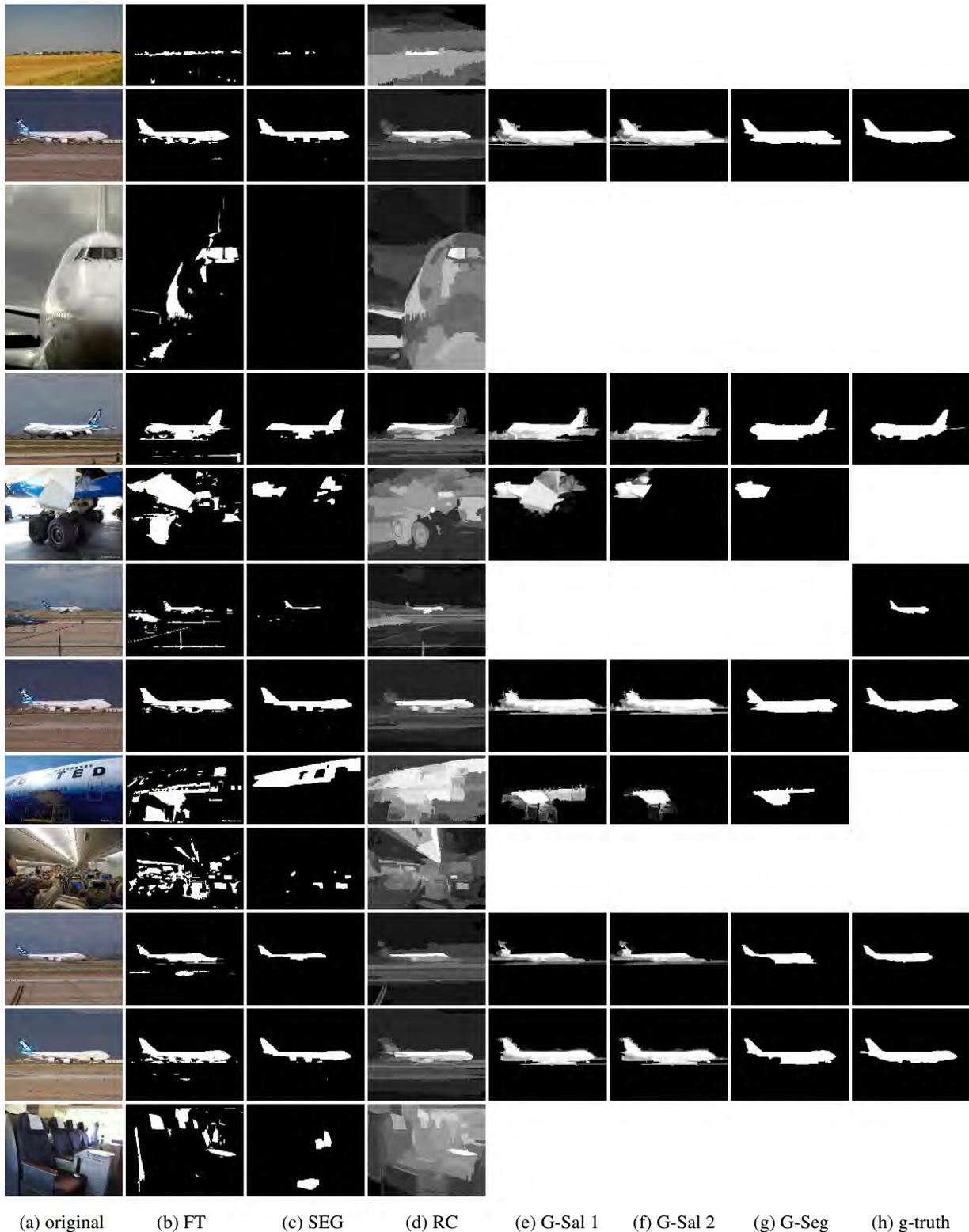
Figure 46: *Group saliency segmentation examples for 'giraffe': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
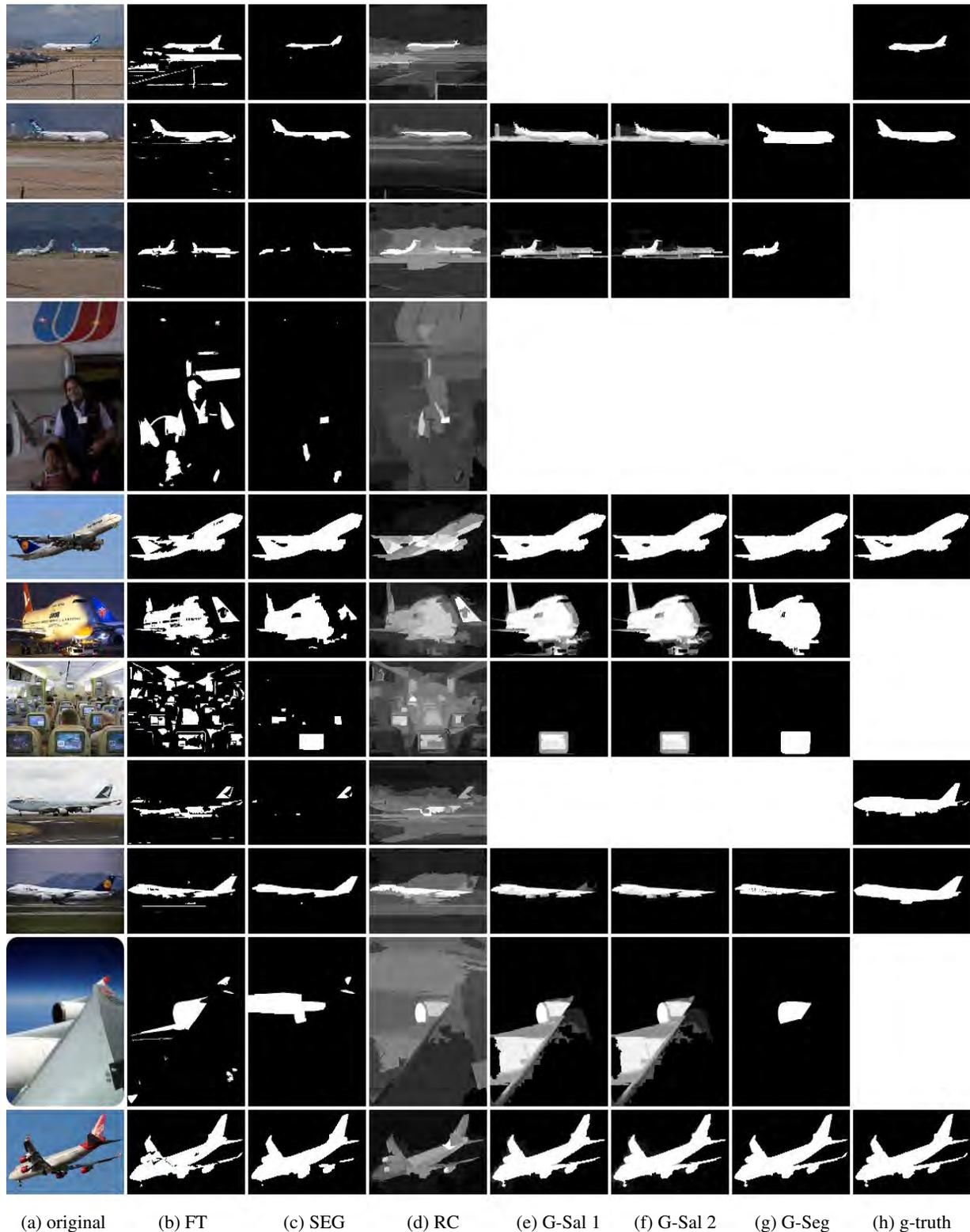
Figure 47: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
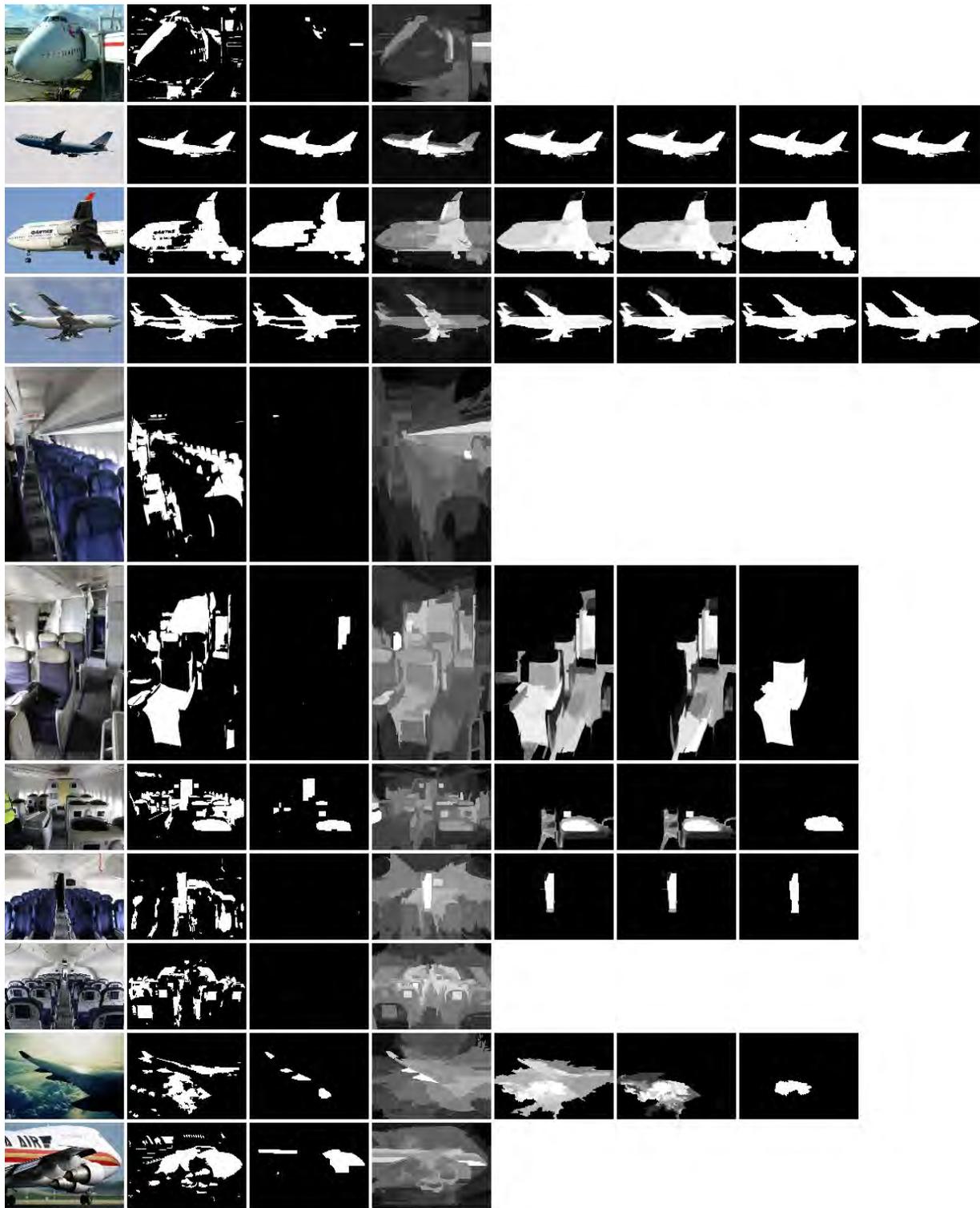
Figure 48: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 49: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

  (a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth
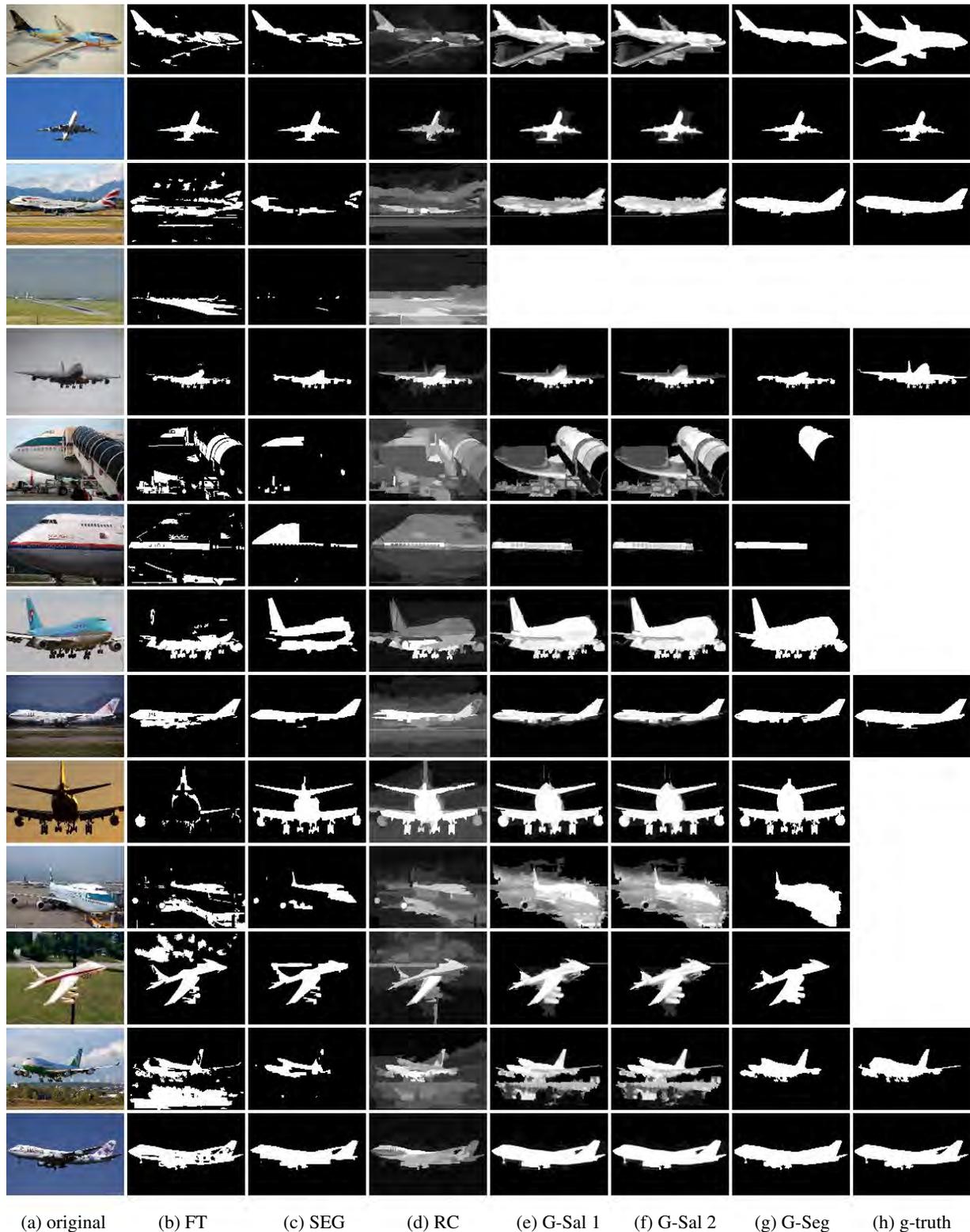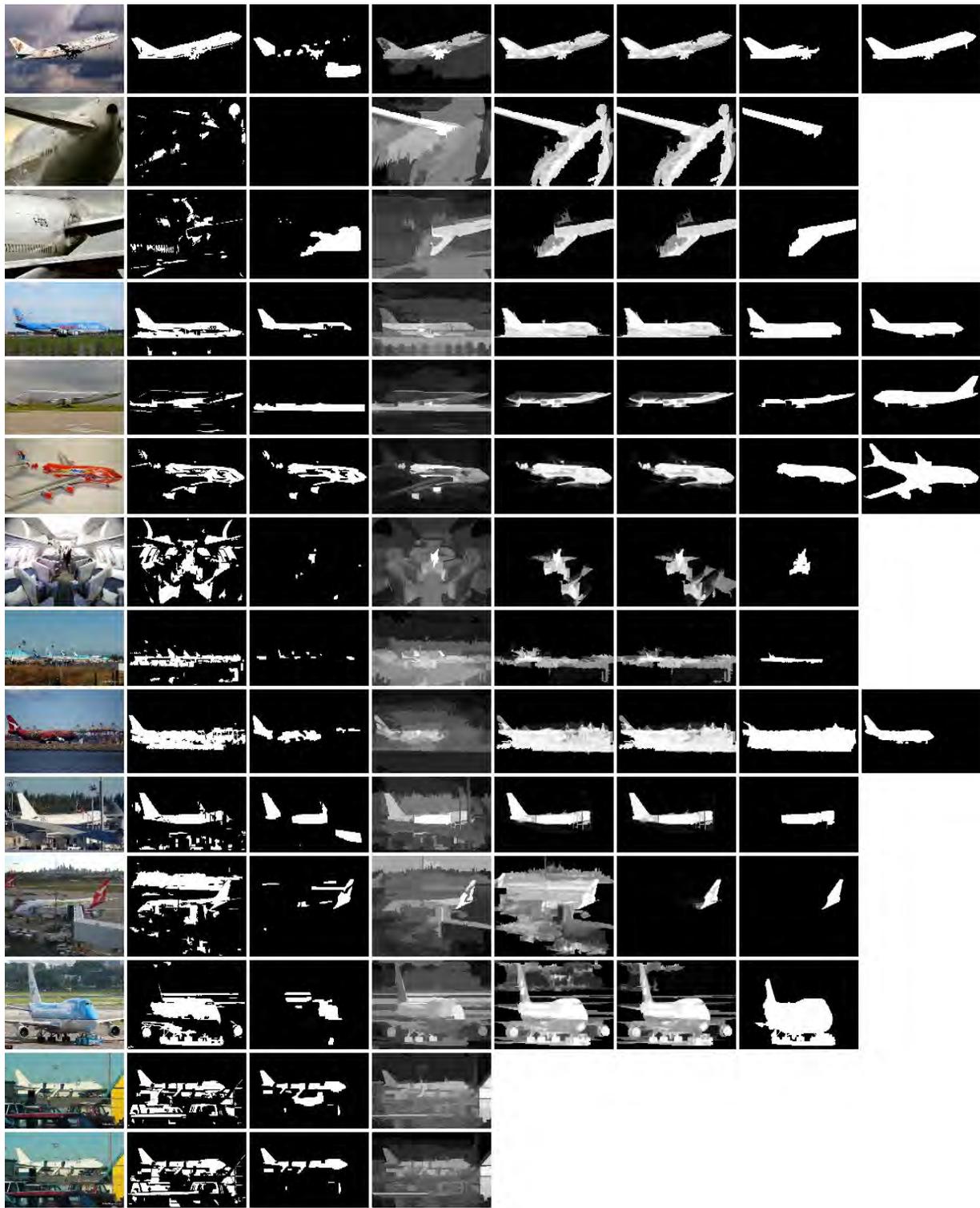
Figure 50: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM* 11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 51: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 52: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 53: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

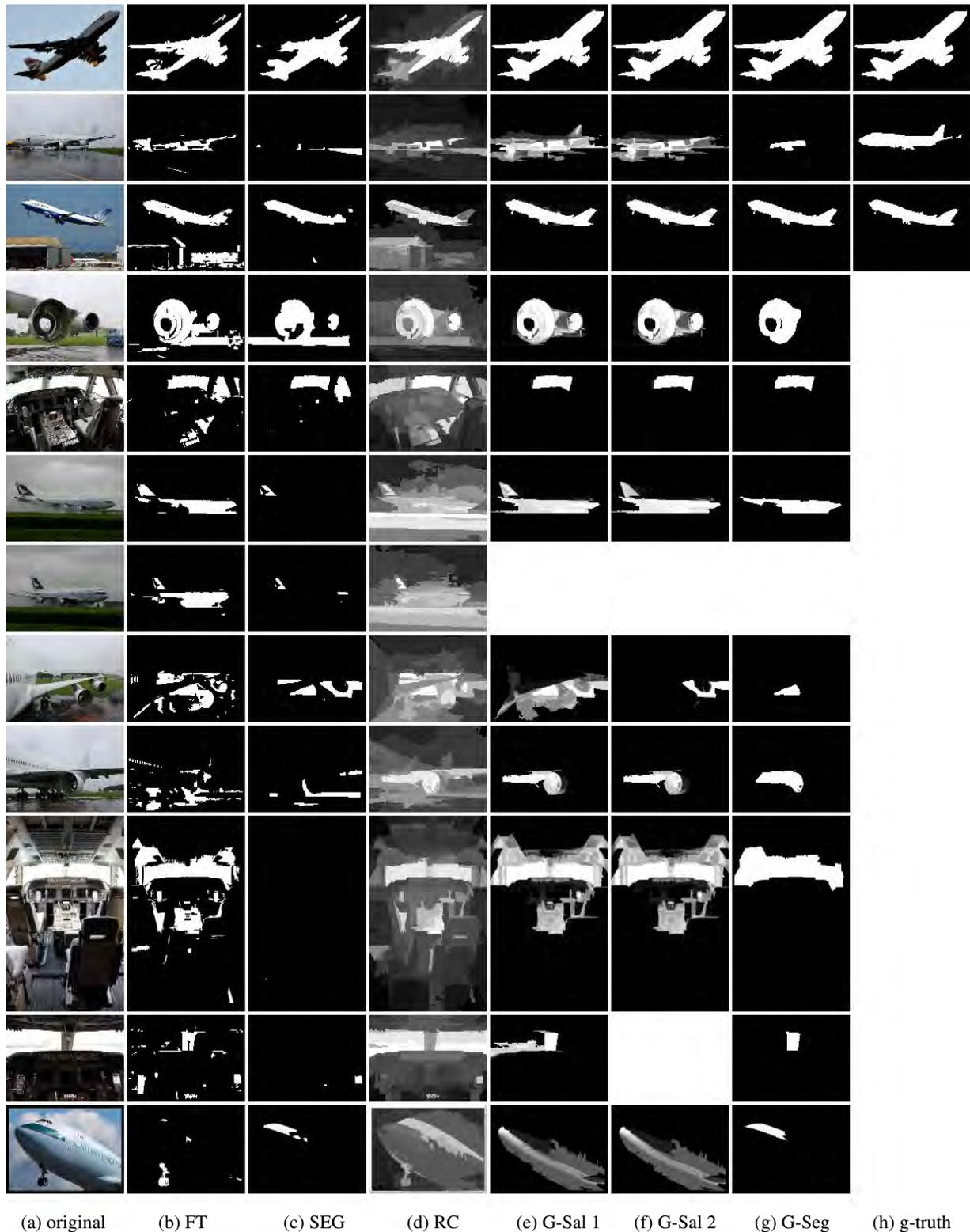(a) original   (b) FT   (c) SEG   (d) RC   (e) G-Sal 1   (f) G-Sal 2   (g) G-Seg   (h) g-truth

Figure 54: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

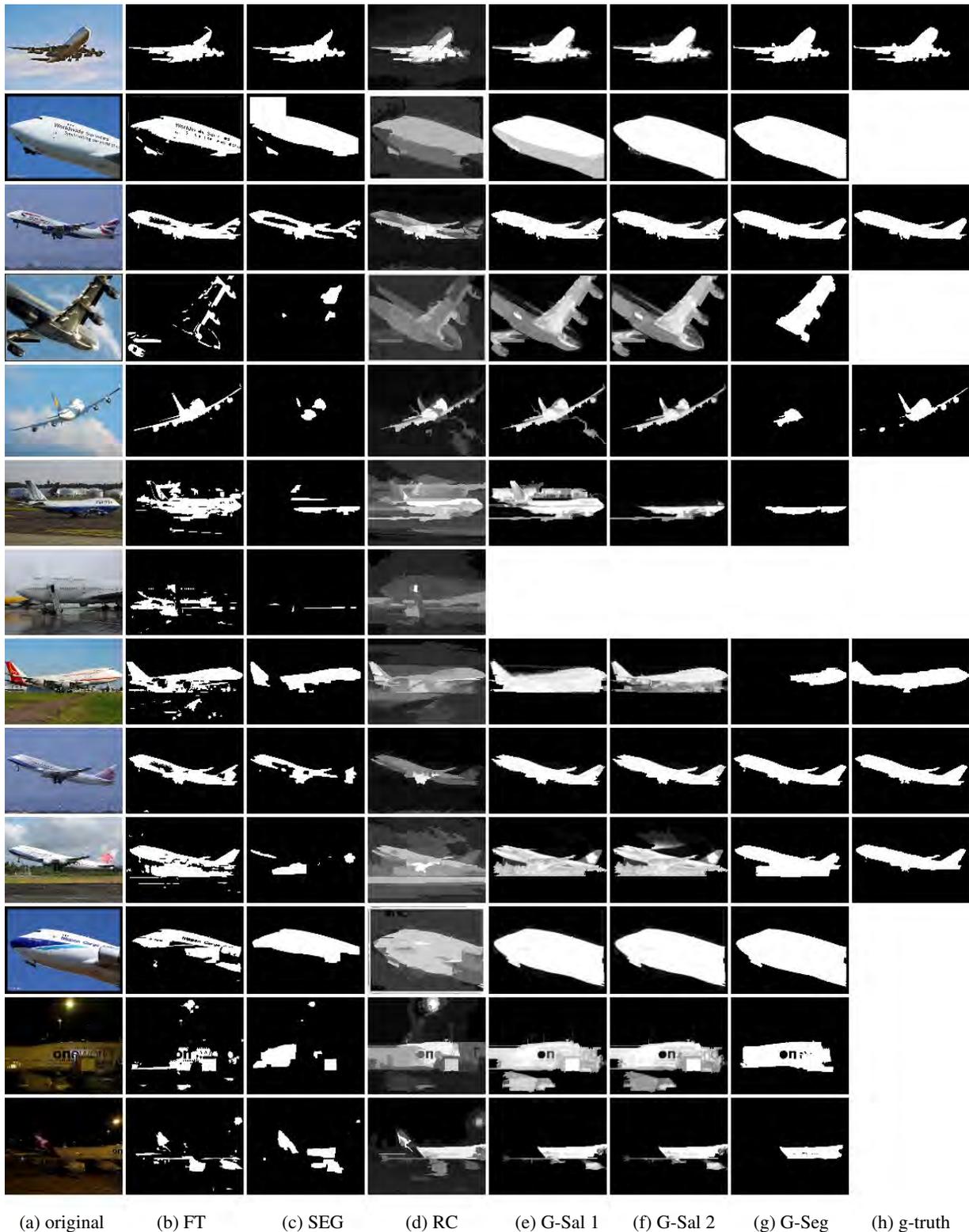| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 55: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*

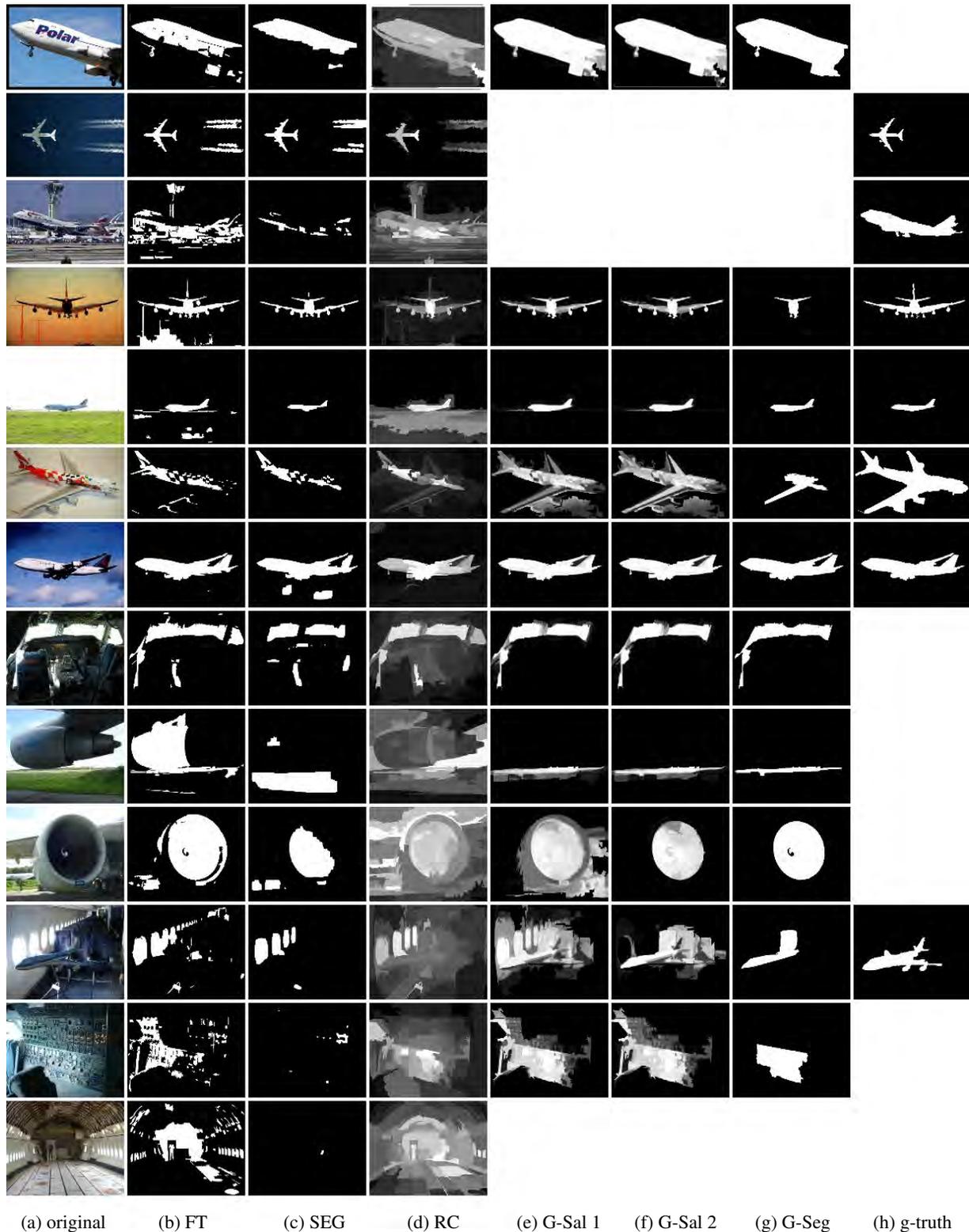| (a) original | (b) FT | (c) SEG | (d) RC | (e) G-Sal 1 | (f) G-Sal 2 | (g) G-Seg | (h) g-truth |

Figure 56: *Group saliency segmentation examples for 'plane': (a) original image, (b) FT [AHES09] segmentation, (c) SEG [RKSH10]) segmentation, (d) saliency map by state-of-the-art single image saliency detection method RC [CZM*11], (e) group saliency (1st iteration), (f) group saliency (2nd iteration), (g) group saliency segmentation, (h) g-truth*