THE INSTITUTE OF ELECTRONICS,
INFORMATION AND COMMUNICATION ENGINEERS

TECHNICAL REPORT OF IEICE

The Method for Presentation of Observed Regions Using Stomap in Virtualized Endoscope System

Ryosuke KONO Yoshito MEKADA Kensaku MORI

Ichiro IDE Hiroshi MURASE Jun-ichi Hasegawa

Graduate School of Information Science, Nagoya University, Furo-cho, Chikusa-ku, Nagoya-shi, 464-8603 Japan

Life System Science and Technology, Chukyo University, 101 Tokodachi, Kaizu-cho, Toyota-shi, 470-0393 Japan

E-mail: rkono@murase.nuie.nagoya-u.ac.jp

Abstract In this paper, we propose a method for automated segmentation of gastric segment named Stomap from 3D abdominal X-ray CT images and its application for the navigation-based diagnosis system. The gastric segment enables us to recognize the position in stomach while diagnosing stomach using virtualized endoscope system. It can also be utilized as a criterion of the appropriateness of navigation path. The number of observed time for each segment based on the gastric segment is proposed for the evaluation of navigation path. The result showed that the distribution of observation time and the shape of navigation path correlated each other.

Keyword Computer-Aided Diagnosis, 3D abdominal X-ray CT images, Gastric Segment(Stomap), Virtualized Endoscope System

1.

… " CT ə ⁹⌈ ⸢ ' ə –
⸢ ' ض ⸢ — ₇ ə ۊ ° ۶ e
↕ ⌐ ← ≈ ə ` ' ⸢ ₄ ₇ ' ⸢ †
` • – ′ ' ə ` ' ' ع⸢
† ` • — ₇

2. ' ⌈ e ↕ ⌐ ← ≈

2.1

" ⸢ ⁵ ₆ ⸢ e ₇ ` ' ق … ⌈ ' ⸢ ₇ ₀ ə ۊ ə ` ′ † ΄0 ' ض⸢ ₇ ′ ' ₀ ⸢ " ⁹ ' Ώ ⸢ ₈ • ` ₇ ق ⸢ " 1 ' ₄ ۊ⸢ ط ⸢ – ⁵ ' 2 ' ₄ ۊ⸢ ə ₆⸢ – ′ ' ə ⸢ — ₇ ⌈ Ώ `

⸢ ΄0 ` • " 1 ' ₄ ۊ⸢ ⁵⸢ ⸢ ₈ ' ⁹ ' Ώ ` ⁵ ₈ ₇ ⌈ Ώ ` ⁵ ' ′ ₈ ⁵ ' ' ⸢ † ` • " ⸢ " ₈ • ` ` [3-7]

2.2

e ↕ ⌐ ← ≈⌈ " ′ — ₇ ' ' 1 † … ₆ 3 ' ₄ ۊ ' … ə " ' ⁹ ' … ₇ ' Ώ ⸢ – … ⸢ ض — ₇ Ώ ⸢ – • ` ₇ ' ⸢ ₄ ₆ ə 77 ' ض⸢ – ′ ₈ , ₈ Ḫ ط ₄ ₆ Ḫ " ⌈ ` " ' ₄ ۊ⸢ ⁵ ₈ • ` ₇

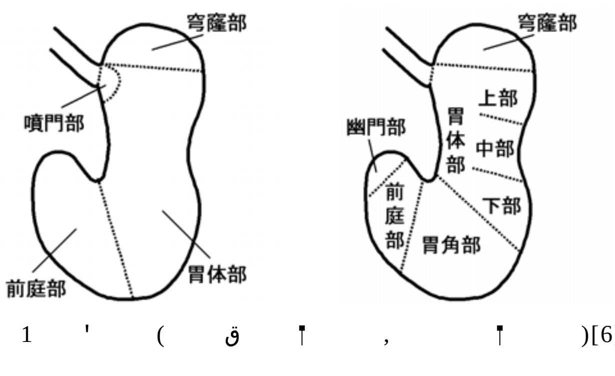
3 ' ə ₇ ⌈ ə ⌈ – • ∩ ₦ ╗ ↕ ⌡⸢ – • 3 ⸢ e ↕ ⌐ ← ≈ ə ⌐ ← ∟ ╗ ₵ ₇ ⌈ ` ۊ ⁹ e ₈ • ` ₇ [8] ′ ' ⸢ ΄0 ` • " ₄ ₆ ' ə 7 – ′ ₈ , ₈ ə ⌈ … e ↕ ⌐ ← ≈ … ' ⌈ • ` ₇

3. e ↕ ⌐ ← ≈⸢ ‡ ` ' '

3 CT ΄0 ₅ – ' ⸢ – • e ↕ ⌐ ← ≈⸢ ‡ Ώ ′ ' ⸢ — ₇ — ₇ ə — ₇ ° ۶ … ط ⸢ † ` • — ₇

3.1

3 X CT ΄0 ₅ ⸢ ₄ " • – ' (° ۶) ' 3 2 ə ⌈ — ₇ (4) ⁵ ' e ↕ ⌐ ← ≈ ' ۶ ⸢ — ₇ 2 $\mathbf{P}_1$ $\mathbf{P}_2$ ΄0 ₄ !! , … ' ⌈ ' $\mathbf{P}_3$ $\mathbf{P}_4$ ə … ۛ õ ' (3,4)



1 ' (ق ,)[6]

3.2 ,

⸢ ' (6) " ′ ₈ , ₈ ə ⌈ ' $\mathbf{P}_3$ $\mathbf{P}_4$⌈ ۶ $\mathbf{P}_2$⌈ ' ə ⸢ ۊ ⸢ 7ÖS ⸢ — ₇ ₄ ۊ ə ⁶ ΄0 † Y (΄0 ₅) ⸢ ⌈ ⁸ ₇ ⸢ … S " Ώ ' ⸢ " • ₅ ΄0⸢ ₈ ₇ ₄ ۊ⸢ ə — ₇ … ₇

1) ' F ə Y ⸢ – 2 2 G ə ₇ (4)

2) 1) … ₅ ₈ ' G⸢ ΄0 ` • 4 ⸢ ə ' ` ə ⌈ – ⁵ ' F⸢ ΄0 ` • 26 ⸢ ə ' ` ə ⌈ — ₇ ⌈ … ′ ₈ , ₈⸢ ΄0 ₇ ə — ₇

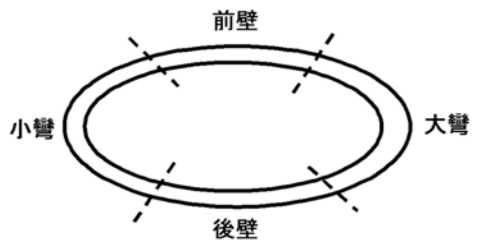
3) Y⸢ ΄0 ` • e ↕ ⌐ ← ≈ ' ⌈ ' $\mathbf{P}_3$ $\mathbf{P}_4$⌈ e ↕ ⌐ ← ≈ ' ۶ $\mathbf{P}_2$ … ₈ ₇ $\mathbf{P}_3\mathbf{P}_2$, $\mathbf{P}_4\mathbf{P}_2$ ə ′ ₈ , ₈ 7ÖS – ⌈ ə L_n … ⁝ ' " – ΄0 ₅ ۶ ⸢ ⸢ L_1, L_2, L_3, , $L_{6ÖS+1}$⌈ — ₇

4) 3) … ₅ ₈ ' L_n ə 3 F⸢ – ⌈ ə ⁝ Z_n ə ₇ (5)

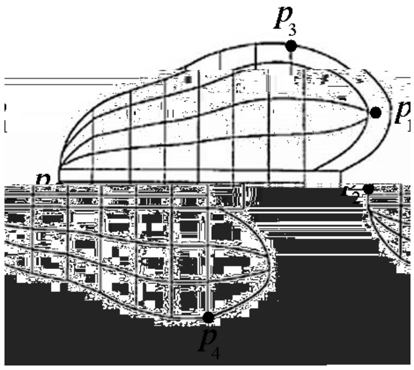
3.3

⸢ ۊ ' (6) " 3.2 … ' ⸢ ' ə ق ' … – ′ ₈ , ₈ ə … !! ' ' س ⸢ — ₇ ⌈ … ₇

1) Z_n ' ' ۊ " ⁹ ' ' ض ≡ ₴ ↕ ┼ ə f'_n ' ' ض ≡ ₴ ↕ ┼ ə g'_n⌈ — ₇⌈ Ώ ' ض ≡ ₴ ↕ ┼ f_n g_n " — ₇ 2 ' ض ' — ₈ ə õ ₇ ' ₈ ° ۶ ' (1),(2)⸢ ₄ " • ə ` ₈ ₇

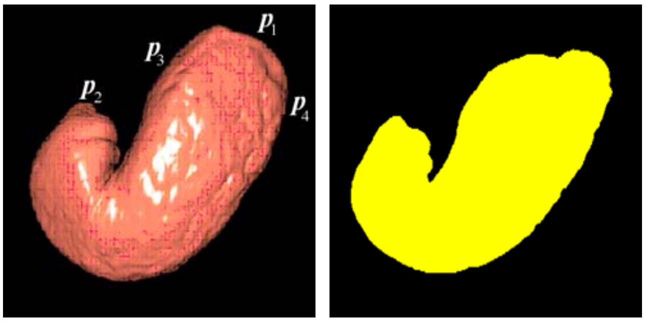


2. '



3 e ↕ ⌐ ← ≈

($\mathbf{P}_1$,$\mathbf{P}_2$ " e ↕ ⌐ ← ≈ ' ۶ ' ə – $\mathbf{P}_3$ $\mathbf{P}_4$ " , … ' ⌈ ' ə —)



4. (Y)

($\mathbf{P}_1,\mathbf{P}_2$ " e ↕ ⌐ ← ≈ ' ə –
$\mathbf{P}_3$ $\mathbf{P}_4$ " , … ' ⌈ ' ə –)

$$f_n = \mathrm{T}\times f_{n-1} + (1-\mathrm{T})\times f'_n \quad (1)$$

$$g_n = \mathrm{T}\times g_{n-1} + (1-\mathrm{T})\times g'_n \quad (2)$$

… T " ə – · ┬ – ╠ ⅜ … 6
0 Ό 5 1 ' ' ə ⌈ 7
2) Z_n Ό • f_n g_n ' 2 ' ə
– ' ə e ↕ ⌐ ← ≈ ' Ό 5
(3:6:6:6:2:1) ' – 7 4 ə 8 7
… Z_n ' m ' ə $D(n,m)$ ⌈ – 7
3) $D(n,m)$ ⌈ $D(n+1,m)$ ə ⋮ ə ' (3) … 8
7 ' ' $N_{n,m}$ ' –
ə 7 (6)

$$N_{n,m} = \frac{H_1 + H_2 + H_3 + H_4}{4} \quad (3)$$

… $H_i(i=1,2,3,4)$ " $D(n,m)$ ⌈ $D(n+1,m)$ ə ⋮
⌈ ' 8 ⌈ – 7 4 † ' ⌈ ' ə –

3.4

' (8) " 3.2 … 8
' ə ' … –
7 ⌈ $\mathbf{P}_1$ $\mathbf{P}_2$ ə ⋮ ə ' '
' – 7 ⌈ … 7
1) ' " $D(S,n)$ ⌈ $\mathbf{P}_1$ ⋮ ə '
(4),(5) … 8 7 ' $N_{n,m}$ '
– 7 (7)

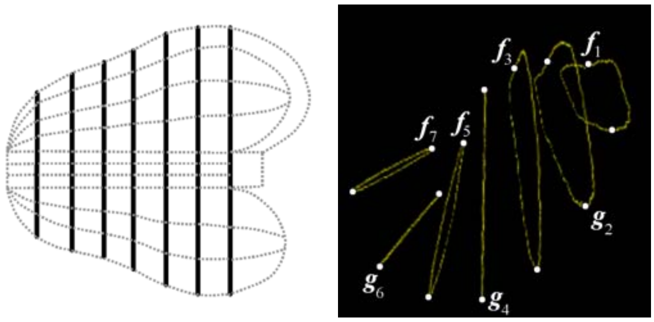
$$N_m = \frac{H_{S,m,S,m+1,P_1} - H_{S,m,S,m-1,P_1}}{2} \quad (4)$$

$$H_{n_1,m_1,n_2,m_2,p} = (\mathbf{P} - D(n_1,m_1)) \times (D(n_1,m_1) - D(n_2,m_2)) \quad (5)$$

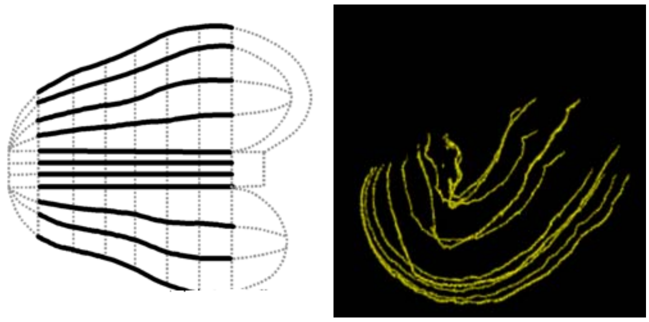
… H " $\mathbf{P}$ ⌈ $D(n_1,m_1)$ $D(n_1,m_1)$ ⌈ $D(n_2,m_2)$ ə
⋮ ⌈ ' ə – $\mathbf{P}$ " ' ə –
2) ' " ⌈ ' … 7

3.5

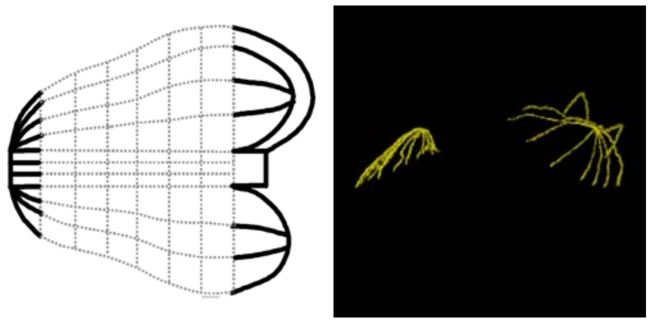
… 8 4 " • 8 7 e ↕ ⌐ ← ≈
' ' ə – 7
1) … 8 ' Ui ə 4 † 5
" 3 † ' D ' ə 8 7
2) 3 F Ό • ə ⌈ – 6
' ┬ ≡ ⊥ ╗ ₵ ə
3) 2) … ┬ ≡ ┼ 8 l – • 8 , 8
C_l ə – 7



5. , ⌈ '
(e ↕ ⌐ ← ≈ ' ( ))



6. '
(e ↕ ⌐ ← ≈ ' ( ))



7. '
(e ↕ ⌐ ← ≈ ' ( ))

4) C_l – • U_i ⌈ ' Ώ 9 7 i
ə 8 l 5 8 7 • ' – • i
– 7 ┬ ≡ ┼ ə – 7

3.6

' – • 9 e ↕ ⌐ ← ≈ ' ə 6
• 7 " ' ' 26
9 – 7 6 • 7
' 4 6 e ↕ ⌐ ← ≈ ⌈ "
' ə – 8
" 0 Ώ ' 5 8 ⌈ – • 8 7 ⌈ ⌈ 7
… " 5 8 ə e ↕ ⌐ ← ≈ ⌈ ⋮

4.

VES … " · ┬ – ╠ ⅜ ⌈ – • v
d ' Ώ u ' 3 † ' ≡ ↕ ┼ ə
8 7 ⌈ 4 6 ə … Ώ 7
" • ə – 7 "

$Q_i = (v_i, d_i, u_i)$ … VES …

4.1

v … d …

4.2

VES …

5.

5.1

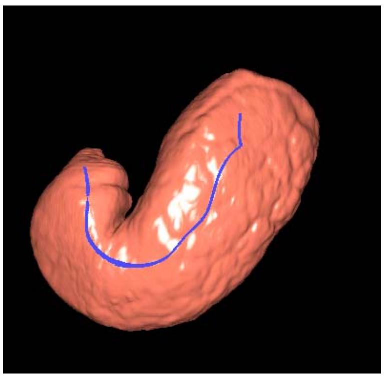
CT … 4 …

S=5 …

T=0.8 …

2 … 8 …

1 … 2 … 1 … 3 …



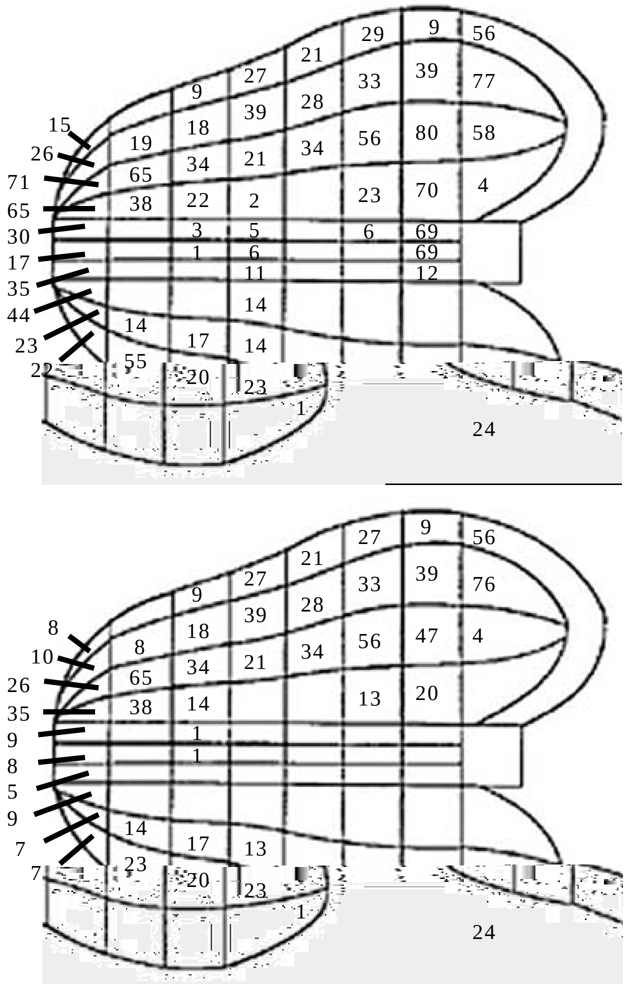
11.

5.2

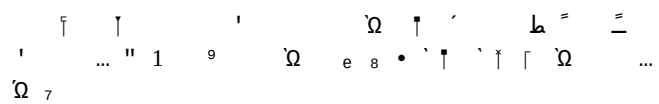
(9) … 4 … (10)

VES … VES … 1 … 280 … 1 … (11)

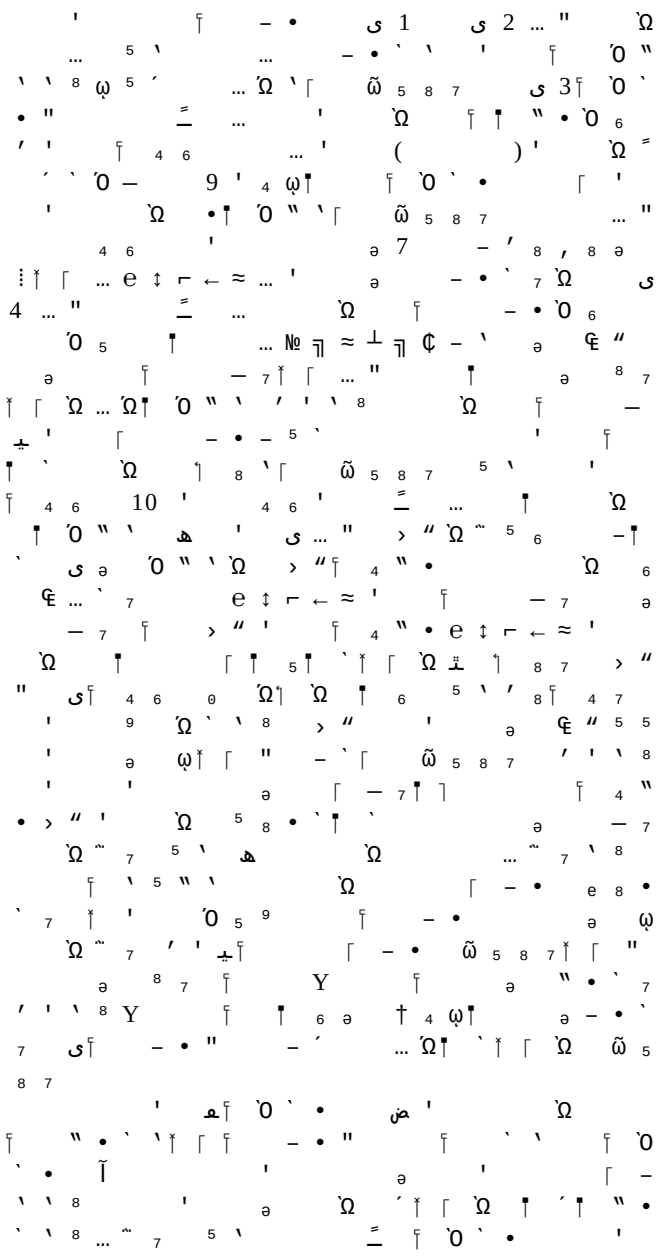
60 … 12 … 50mm … 12 …

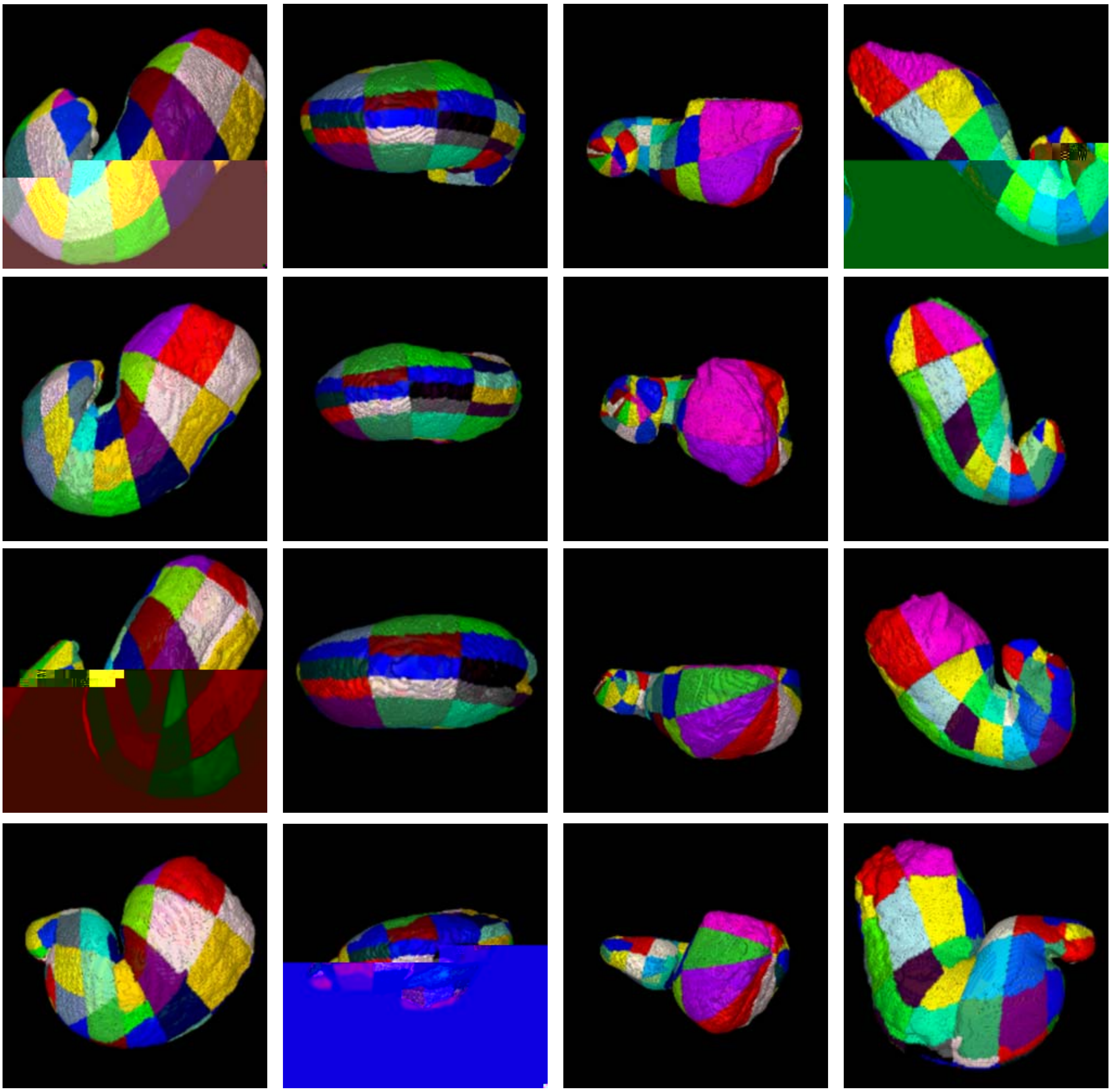


12. … (…) (… 50mm …)



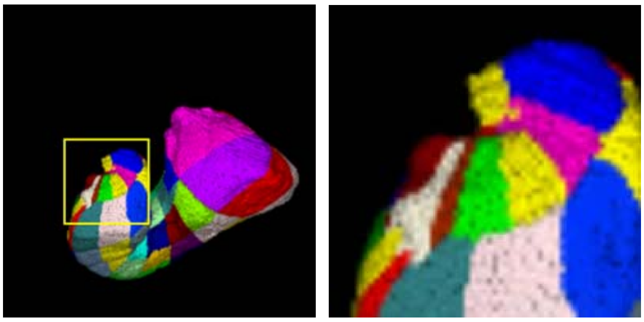
6.



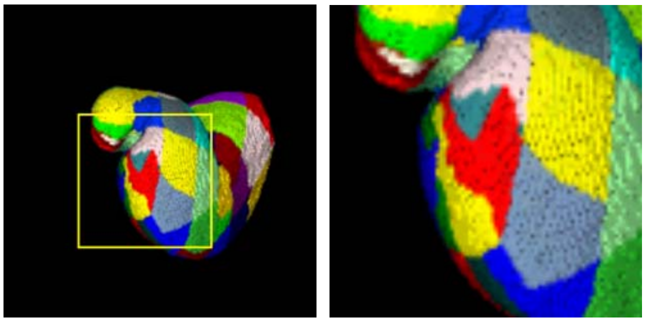


(a) (b) (c) (d)

8 ' (a) (b) ُ (c) ً (d) ΄0 ₅ – `
ً ΄0 ₅ ی 1 ی 2 ی 3 ی 4 ' ə –



9 ی 3أ ΅0 ` • ΅Ω – `
( ) (:)



10 ی 4أ ΅0 ` • ΅Ω – `
( )(:)