

ustry Science and Engineering Vol. 1 No. 3, 2024
 Research on Underwater Distance Measurement of Binocular

Vision by Semantic Separation Picture

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Leicester International Institute, Dalian University of Tec *Engineering Vol. 1 No. 3, 2024*
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 Vision by Semantic Separation Picture

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Vision by Semantic Separation Picture

Leicester International Institute, Dalian University of Technology, Panjin, Liaoning, Chi** *The Academic Et (1 No. 3, 2024*
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 Sijia Ren^{}

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Vision by Semantic Separation Pictu

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<i>Migia Ren^{*}*
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effectively reduces the computational characteric
burden of unrelated regions. At the same
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to flexibly respond to texture changes in sens **Example 18 The Samurity dynamic and time, a texture similarity dynamic performance of the angly threshold to texture changes in the the proposed to the different regions, thereby greatly improving information from differe** From the and texture similarity dynamic performance of the distinguisament-matching window is established proposed to use different regions, thereby greatly improving information from the matching speed and accuracy. At pr **IMAGE ATT SCROM SETT:**
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foundati** the matching speed and accuracy. At present, the bu

Experiments show that the ranging speed is

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Experiments show that the ranging speed is

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Keywords: Semantic Segmentation;

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Sinocular Vision; Ranging; Underwater

Imaging; Region Matching

1. Introduction

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The binocular camera cons

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 1. Introduction

There are four main methods for underwater

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The proposed and Nakajima [4] proposed and

proposed and Nakajima [4] proposed and Nakajima [4] proposed underwater pipeline detection method based **Example 15 Proposed School Procedure Proposed School Procedure Author:**

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performance of the system. Balasuriya et al. [9]
proposed to use CCD cameras and acoustic
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information from underwater pipelines.
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information from underwater pipelines.
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ranging of sensors to obtain three-dimensional
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At present, the binocular ranging technology
for underwater targets is still blank. The target
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At present, the binocular ranging technology

for underwater targets is still blank. The target

ranging of binocular vision simulates the

visual system of human eyes, and infers th

At present, the binocular ranging technology
for underwater targets is still blank. The target
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visual system of human eyes, and infers the
distance of the target object by calcula for underwater targets is still blank. The target
ranging of binocular vision simulates the
visual system of human eyes, and infers the
distance of the target object by calculating the
parallax between the two cameras [10 ranging of binocular vision simulates the
visual system of human eyes, and infers the
distance of the target object by calculating the
parallax between the two cameras [10, 11].
The binocular ranging process mainly includ visual system of human eyes, and inters the
distance of the target object by calculating the
parallax between the two cameras [10, 11].
The binocular ranging process mainly includes
binocular camera calibration, binocular distance of the target object by calculating the
parallax between the two cameras [10, 11].
The binocular ranging process mainly includes
binocular camera calibration, binocular
correction and stereo matching.
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The binocular ranging process mainly includes
binocular camera calibration, binocular
correction and stereo matching.
2. **Binocular Vision Ranging Principle**
The binocular camera Translate [10, 11].

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Due to the baseline distance between the two
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2. Binocular Vision Ranging Principle
The binocular camera consists of two cameras.
Due to the baseline distance between the two
cameras, when the same object appears in both
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The binocular camera consists of two cameras.
Due to the baseline distance between the two
cameras, when the same object appears in both
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The binocular camera consists of two cameras.
Due to the baseline distance between the two
cameras, when the same object appears in both
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get, Q_i is the optical
 Q_i , Q_r is the optical
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Due to the baseline distance between the two
cameras, when the same object appears in both
picturest the same time, the position of the
object in the two pictures
swill hav Due to the bassime usstance between the two
cameras, when the same object appears in both
picturesat the same time, the position of the
object in the two pictureswill have a certain
offset. The schematic diagram shown as

Ranging

follows:

$$
\frac{T - (X_t - X_r)}{T} = \frac{Z - f}{Z} \tag{1}
$$

$$
Z = \frac{f}{X_i - X_r} = \frac{f}{d} \tag{2}
$$
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Education
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 *X***₁** is the imaging length of *OA*
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X₁ is the imaging length of
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 αA in the virtual camera, and
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Ranging

As shown in Figure 1, the formula is as

follows:
 $\frac{T - (X_i - X_r)}{T} = \frac{Z - f}{Z}$ (1)

The distance Z from the target to the camera

can be obtained as follows:
 $Z = \frac{fT}{X_i - X$ Figure 1. Principle of Binocular Visual

Ranging

As shown in Figure 1, the formula is as

follows:
 $\frac{T - (X_t - X_r)}{T} = \frac{Z - f}{Z}$ (1)

The distance Z from the target to the camera

can be obtained as follows:
 $Z = \frac{f}{X_t - X_r$ **EXECUTE:** As shown in Figure 1, the formula is as

follows:
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The distance Z from the target to the camera

can be obtained as follows:
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 $\frac{T-(X_i-X_r)}{T} = \frac{Z-f}{Z}$ (1) From the a

can be obtained as follows:
 $Z = \frac{fT}{X_i - X_r} = \frac{fT}{d}$ (2) 1.33 times

Among them, $d = X_i - X_r$, is the parallax of

the two cameras, X_i and X_r are the Due to the absciss The distance Z from the target to the camera

can be obtained as follows:
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the two cameras, X_1 and X_2 are the Due to

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can be obtained as follows:
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Among them, $d = X_i - X_r$, is the parallax of

the two cameras, The unstance 2 Form the unique of the camera
 $Z = \frac{f}{X_1 - X_r} = \frac{fT}{d}$ (2) 1.33 times of the actual

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Example the strategy of the particle is $Z = \frac{f}{X_1 - X_r} = \frac{f}{d}$ (2) 1.33 times of the act

Among them, $d = X_1 - X_r$, is the parallax of

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Among them, $d = X_1 - X_r$, is the parallax of

the two cameras, X_1 and X_r are the Due to the error of t

abscissa of the pixels of the *p* point in the instal Among them, $d = X_t - X_r$, is the parallax of
the two cameras, X_t and X_r are the Due to the error of t
abscissa of the pixels of the P point in the installation, the main point
left and right pictures
respectively, f Among them, $d = X_1 - X_2$, is the parallax of

the two cameras, X_i and X_r are the

abscissa of the pixels of the p point in the

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left and right pictures

focal length, and T is the baseline. the two cameras, X_i and X_r are the Due to the error of the absolutions of the pixels of the p point in the installation, the main point left and right pictures
respectively, f is the the center point, and is to th abscissa of the pixels of the *p* point in the

left and right pictures

respectively, *f* is the

focal length, and *T* is the baseline.

focal length, and *T* is the baseline.

that is:

3. **Underwater Picture Analysis** left and right pictures
respectively, f is the center point, and it introduce offsets c_x and
focal length, and T is the baseline.
3. Underwater Picture Analysis
The process of the light reflected by the underwater obj Figure 2, the baseline.
 S. Underwater Picture Analysis

The process of the light reflected by the $x_{\text{mean}} = f_s \left(\frac{X}{Z} \right) + c_s$, $y_{\text{mean}} = f_s \left(\frac{X}{Z} \right) + c_s$, $y_{\text{mean}} = f_s \left(\frac{X}{Z} \right) + c_s$, $y_{\text{mean}} = f_s \left(\frac{X}{Z} \right) + c_s$, $O₂$ is the intersection of the incident light in Express of the light reflected by the

ervwater object reaching the camera

intersections. One is the refraction

water and lens, and the other is the

action of lens and air. It is assumed that the

cal axis of the camer the matrix of extension of the effection content into the refraction

requires two or feraction of lens and dir. It is assumed that the

optical axis of the camera is perpendicular to

optical axis of the camera is perpen refraction of lens and air. It is assumed that the
optical axis of the camera is perpendicular to
the horizontal plane of refraction, and the
refraction of lens and air is neglected. The
simplified model of underwater ima refraction:

Industry Science and Engineering Vol. 1 No. 3, 2024

*X X*₁ is the imaging length of *OA* in the real
*X*₁ is the imaging length of *OA* in the real
CA in the virtual camera, and *X*₁ = *X*₂, the
CA in the virtual camera, and *X*₁ = *X*₂, the
Following re y Science and Engineering Vol. 1 No. 3, 2024
 X_1 is the imaging length of OA in the real

time camera, X_2 is the imaging length of
 OA in the virtual camera, and $X_1 = X_2$, the

following results can be obtained *v* Science and Engineering *Vol.* 1 *No.* 3, 2024
 *X*₁ is the imaging length of *OA* in the real

time camera, *X*₂ is the imaging length of
 OA in the virtual camera, and *X*₁ = *X*₂, the

following results c *y* Science and Engineering *Vol.* 1 *No.* 3, 2024
 X_1 is the imaging length of OA in the real

time camera, X_2 is the imaging length of
 OA in the virtual camera, and $X_1 = X_2$, the

following results can be obta *cinering Vol. 1 No. 3, 2024*
g length of *OA* in the real
is the imaging length of
camera, and $X_1 = X_2$, the
an be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OO_1}$ (4)
 $\frac{X_2}{OA} = \frac{f_2}{OO_2}$ (5)
 $\frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \$ *cinering Vol. 1 No. 3, 2024*
g length of OA in the real
is the imaging length of
camera, and $X_1 = X_2$, the
an be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OO_1}$ (4)
 $\frac{X_2}{OA} = \frac{f_2}{OO_2}$ (5)
 $\frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta$ *cinering Vol. 1 No. 3, 2024*
g length of *OA* in the real
is the imaging length of
camera, and $X_1 = X_2$, the
an be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OO_1}$ (4)
 $\frac{X_2}{OA} = \frac{f_2}{OO_2}$ (5)
 $= \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin$ **ring Vol. 1 No. 3, 2024**

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the imaging length of

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 $\frac{f_1}{OO_1}$ (4)
 $\frac{f_2}{OO_2}$ (5)
 $\frac{\theta_1}{\theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)

s, it ca *nd Engineering Vol. 1 No. 3, 2024*

imaging length of *OA* in the real

a, X_2 is the imaging length of

virtual camera, and $X_1 = X_2$, the

sesults can be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OO_1}$ (4)
 $\frac{X_2}{OO_2} = \frac{f_2}{OO_$ *y* Science and Engineering *Vol.* 1 No. 3, 2024
 X_1 is the imaging length of OA in the real

time camera, X_2 is the imaging length of
 OA in the virtual camera, and $X_1 = X_2$, the

following results can be obtain

$$
\frac{X_1}{OA} = \frac{f_1}{OO_1}
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 (4)

$$
\frac{X_2}{OA} = \frac{f_2}{OO_2} \tag{5}
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\frac{f_1}{f_2} = \frac{OO_1}{OO_2} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}
$$
 (6)

Exercise Exercise Contained Solution

Final Bridge Contained Scheme and Engineering Vol. 1 Note that the camera, X_2 is the imaging length of OA if the camera, X_2 is the imaging OA in the virtual camera, and X_1 **Education**
 Industry Science and Engineering Vol. 1
 Y_1 is the imaging length of OA

time camera, X_2 is the imagin
 OA in the virtual camera, and X

following results can be obtained:
 $\frac{X_1}{OA} = \frac{f}{OO}$
 Rang From the above analysis, it can be seen that the **o**
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** $\frac{X_1}{Y_1}$ **is the imaging length of** O **

time camera,** X_2 **is the imaging
** OA **in the virtual camera, and** $\frac{X_1}{OA}$ **

Principle of Bino** 1.33 times of the actual focal length. **thereform** *Col. 1 No. 3, 2024*

length of *OA* in the real

is the imaging length of

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le obtained:
 $\frac{1}{4} = \frac{f_1}{OO_1}$ (4)
 $\frac{f_2}{f_1} = \frac{f_2}{OO_2}$ (5)
 $\frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2$ teering Vol. 1 No. 3, 2024

length of OA in the real

is the imaging length of

amera, and $X_1 = X_2$, the
 $\frac{1}{4} = \frac{f_1}{OO_1}$ (4)
 $\frac{1}{4} = \frac{f_2}{OO_2}$ (5)
 $\frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1$ *e* **and Engineering Vol. 1 No. 3, 2024**

the imaging length of OA in the real

nera, X_2 is the imaging length of

the virtual camera, and $X_1 = X_2$, the

g results can be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OO_1}$ (4)
 $\frac{X$ Figure 1.1 The state of OA in the real
time camera, X_2 is the imaging length of
 OA in the virtual camera, and $X_1 = X_2$, the
following results can be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OO_1}$ (4)
 $\frac{X_2}{OA} = \frac{f_2}{OO_2}$ (5)
 X_1 is the imaging length of OA in the real
time camera, X_2 is the imaging length of
 OA in the virtual camera, and $X_1 = X_2$, the
following results can be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OA}$ (4)
 $\frac{X_2}{OA} = \frac{f_2}{OA}$ (time camera, X_2 is the imaging length of
 OA in the virtual camera, and $X_1 = X_2$, the

following results can be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OA}$ (4)
 $\frac{X_2}{OA} = \frac{f_2}{OO_2}$ (5)
 $\frac{f_1}{f_2} = \frac{OO_1}{OO_2} = \frac{\tan \theta_1}{\tan \$ OA in the virtual camera, and $X_1 = X_2$, the

following results can be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OO_1}$ (4)
 $\frac{X_2}{OO_1} = \frac{f_2}{OO_2}$ (5)
 $\frac{f_1}{f_2} = \frac{OO_1}{OO_2} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2$ **Example 10.11 Coordinate Transformation**

During the same obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OA_1}$ (4)
 $\frac{X_2}{OA} = \frac{f_2}{OA_2}$ $= \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)

From the above analysis, it ca $rac{\frac{X_1}{O_A} = \frac{f_1}{O_O}}{\frac{X_2}{O_A} = \frac{f_2}{O_O}}$ (5)
 $rac{X_2}{\frac{f_1}{f_2} = \frac{O_O}{O_O} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)

From the above analysis, it can be seen that the

camera is affected by ref $\frac{X_2}{\overline{O_4}} = \frac{f_2}{\overline{O_2}}$ (5)
 $\frac{X_2}{f_2} = \frac{f_2}{\overline{O_2}} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)

From the above analysis, it can be seen that the

camera is affected by refraction unde $rac{\Delta_2}{\Delta_4} = \frac{J_2}{O_2}$ (5)
 $rac{f_1}{f_2} = \frac{O_0}{O_2} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)

From the above analysis, it can be seen that the

camera is affected by refraction under the

water, $\frac{f_1}{f_2} = \frac{\partial O_1}{\partial O_2} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)
From the above analysis, it can be seen that the
camera is affected by refraction under the
water, and its focal length has chan *x f c y f c ^Z ^Z* ra, X_2 is the imaging length of

virtual camera, and $X_1 = X_2$, the

esults can be obtained:
 $\frac{X_1}{OA} = \frac{f_1}{OQ_1}$ (4)
 $\frac{X_2}{OA} = \frac{f_2}{OQ_2}$ (5)
 $= \frac{OO_1}{OQ_2} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2}$ $\frac{f_2}{\sigma_2}$ (5)
 $\frac{1}{2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)

it can be seen that the

refraction under the

geth has changed. The

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ocal length.
 mation

the camera during

the is $\frac{Q_1}{Q_2} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)

analysis, it can be seen that the

cread by refraction under the

cocal length has changed. The

the undervater camera is about

e actual foca *u b*_{*Q*₁} $\frac{X_2}{\omega_d} = \frac{f_2}{\omega_2}$ (5)
 $\frac{X_1}{\omega_d} = \frac{f_2}{\omega_2} \approx \frac{g_1}{g_2} \approx \frac{\sin \theta_1}{g_2} \approx \frac{g_1}{\sin \theta_2} \approx \frac{g_1}{n_1}$ analysis, it can be seen that the

cocal length has changed. The

cocal length has change $rac{X_2}{OA} = \frac{f_2}{O_2}$ (5)
 $rac{O_1}{OO_2} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)

we analysis, it can be seen that the

ffected by refraction under the

is focal length has changed. The

of the und is can be obtained:
 $\frac{x_1}{0A} = \frac{f_1}{0O_1}$ (4)
 $\frac{x_2}{0A} = \frac{f_2}{0O_2}$ (5)
 $\frac{Q_1}{0A} = \frac{\tan \theta_1}{\theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{n_1} = \frac{n_2}{n_1}$ (6)
 $\frac{Q_1}{0.2} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{n_1} = \frac{n_2}{n_$ $\frac{X_2}{OA} = \frac{f_2}{OQ_2}$ $\frac{O_1}{O_2} = \frac{\tan \theta_1}{\tan \theta_2} \approx \frac{\theta_1}{\theta_2} \approx \frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)

senalysis, it can be seen that the

cected by referation under the

focal length has changed. The

the underwater cam (5)
 $\frac{\sin \theta_1}{\sin \theta_2} = \frac{n_2}{n_1}$ (6)
 \therefore seen that the

changed. The

mera is about

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mera during

nerally not at

necessary to
 $\int_{r_y}^{r_x} \left(\frac{Y}{Z}\right) + c_y$ (7)
 $\left[\frac{Y_c}{Z_c}\right]$ (8)
 $\left[\frac{Y_c}{Z_c}\right]$ ($\frac{V}{\ln \theta_2} \approx \frac{V}{\theta_2} \approx \frac{V}{\sin \theta_2} = \frac{V}{n_1}$ (0)
is, it can be seen that the
py refraction under the
ength has changed. The
derwater camera is about
if ocal length.
ormation
of the camera during
point is generally

water, and its focal length has changed. The
focal length of the underwater camera is about
1.33 times of the actual focal length.
4. Coordinate Transformation
Due to the error of the camera during
installation, the mai **c reformation**
 c c *c* **f c c c** *c c*

$$
c_{\text{screen}} = f_x \left(\frac{X}{Z} \right) + c_x, \quad y_{\text{screen}} = f_y \left(\frac{Y}{Z} \right) + c_y \quad (7)
$$

$$
Z_c \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} f_x & 0 & c_x & 0 \\ 0 & f_y & c_y & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} X_c \\ Y_c \\ Z_c \\ 1 \end{bmatrix}
$$
 (8)

$$
K = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}
$$
 (9)

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sumera
 $x_{\text{screen}} = f_x \left(\frac{X}{Z} \right) + c_x$, y

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The matrix form is as followed

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at the
 $z_c \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} f_x & 0 \\ 0 & f_y \\ 0 & 0 \end{bmatrix}$

and the
 $K = \begin{bmatrix} f_x & 0 \\ 0 & f_y \\ 0 & 0 \end{bmatrix}$

on the sis, it can be seen that the
bergth has changed. The
elerwater camera is about
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of the camera is about
and it is necessary to
and it is necessary to
and c_y ,
 $\frac{1}{x_x}$, $y_{\text{screen}} = f_y \left(\frac{Y}{Z}\right) +$ ralysis, it can be seen that the

ralysis, it can be seen that the

cel by refraction under the

cal length has changed. The

e underwater camera is about

actual focal length.
 A and it is necessary to

c_x and c_y,
 the vector point, and the pixel coordinates of the
 $x_{\text{screen}} = f_x \left(\frac{X}{Z}\right) + c_x$, $y_{\text{screen}} = f_y \left(\frac{Y}{Z}\right) + c_y$ (7)

The matrix form is as follows:
 $z_c \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} f_x & 0 & c_x & 0 \\ 0 & f_y & c_y & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} X_c$ focal length of the underwater camera is about

1.33 times of the actual focal length.

4. **Coordinate Transformation**

Due to the error of the camera during

installation, the main point is generally not at

the center p The matrix form is as follows:
 $z_{\text{screen}} = f_x \left(\frac{X}{Z}\right) + c_x, \quad y_{\text{screen}} = f_y \left(\frac{Y}{Z}\right) + c_y \quad (7)$

The matrix form is as follows:
 $z_{\lfloor t \rfloor} \left[\begin{matrix} f_x & 0 & c_x & 0 \\ 0 & f_y & c_y & 0 \\ 0 & 0 & 1 & 0 \end{matrix}\right] \left[\begin{matrix} Y_x \\ Z_z \\ Z_z \end{matrix}\right]$ (8)
 $K = \begin{bmatrix$ $x_{\text{screen}} = f_x \left(\frac{x}{Z} \right) + c_x, \quad y_{\text{screen}} = f_y \left(\frac{1}{Z} \right) + c_y$ (7)

The matrix form is as follows:
 $z_c \begin{bmatrix} u \\ v \\ u \end{bmatrix} = \begin{bmatrix} f_x & 0 & c_x & 0 \\ 0 & f_y & c_y & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_c \\ x_c \\ x_c \end{bmatrix}$ (8)
 $K = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0$ The matrix form is as follows:
 $Z_e\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} f_x & 0 & c_x & 0 \\ 0 & f_y & c_y & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} X_e \\ Y_e \\ Z_e \\ Y_e \end{bmatrix}$ (8)
 $K = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$ (9)

Among them, the pixel coordinates of the
 $Z_e\begin{bmatrix} y \\ 1 \end{bmatrix} = \begin{bmatrix} 5 & 5 & 0 & 0 & 0 & 0 \ 0 & 0 & 1 & 0 & 0 \ 0 & 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} Y_e \\ Z_e \\ Z_e \end{bmatrix}$ (8)
 $K = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$ (9)

Among them, the pixel coordinates of the

principal point Picturear camera. $K = \begin{bmatrix} s_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$ (9)

Among them, the pixel coordinates of the

principal point Pictureare (c_x, c_y) , u and v are

the pixel coordinates on the u axis (x axis)

and the v axis (y axis), respective Among them, the pixel coordinates of the
principal point Pictureare (c_x, c_y) , u and v are
the pixel coordinates on the u axis (x axis)
and the v axis (y axis), respectively. f is
the actual physical focal length of the $\left(\frac{X}{Z}\right) + c_x$, $y_{\text{stream}} = f_y\left(\frac{Y}{Z}\right) + c_y$ (7)

is as follows:
 $\left[\begin{matrix} u \\ 0 & f_y & c_y & 0 \\ 0 & 0 & 1 & 0 \end{matrix}\right] \left[\begin{matrix} X_x \\ Z_x \\ Z_z \end{matrix}\right]$ (8)
 $K = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$
 $K = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$ principal point Pictureare (c_x, c_y) , u and v are
the pixel coordinates on the u axis (x axis)
and the v axis (y axis), respectively. f is
the actual physical focal length of the camera,
 f_x and f_y are the pixel focal *T F*_{*x*} 0 *C_x* 0 *C_x* 0 $\begin{bmatrix} x_c \\ y_c \\ z_c \end{bmatrix} = \begin{bmatrix} f_x & 0 & c_x & 0 \\ 0 & f_y & c_y & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_c \\ z_c \\ 1 \end{bmatrix}$ (8)
 $K = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$ (9)

the pixel coordinates of the

pictureare $(c_x$ and the v axis (y axis), respectively. f is
and the v axis (y axis), respectively. f is
the actual physical focal length of the camera,
 f_x and f_y are the pixel focal length of the
camera, and K is the internal par and the v axis (y axis), respectively. f is
the actual physical focal length of the camera,
 f_x and f_y are the pixel focal length of the
camera, and K is the internal parameter of the
camera.
5. **SGBM Optimization**
 $X = \begin{bmatrix} 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$

(9)

ie pixel coordinates of the

ttureare (c_x, c_y) , u and v are

ates on the u axis (x axis)

y axis), respectively. f is

al focal length of the camera,

the pixel focal length of th ² pixel coordinates of the

² pixel coordinates of the

tureare (c_x, c_y) , u and v are

tes on the u axis (x axis)

axis), respectively. *f* is

focal length of the camera,

the pixel focal length of the
 the internal $K = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix}$ (9)
the pixel coordinates of the
icture
are (c_x, c_y) , u and v are
nates on the u axis (x axis)
y axis), respectively. f is
cal focal length of the camera,
the pixel focal len

5. SGBM Optimization

$$
T_{\text{pile-leg}} = N \times t_m \tag{10}
$$

$$
T_{total} = W \times t_m \tag{11}
$$

time *L* is the internal parameter of the
 imization

derwater target expressed as:
 $T_{\text{pile-leg}} = N \times t_m$ (10)

time expressed as:
 $T_{\text{total}} = W \times t_m$ (11)

semantic segmentation picture

to original Picture matching
 $\% = \frac{T_{\text{pile$

$$
P\% = \frac{T_{pile-leg}}{T_{total}} = \frac{N \times t_m}{W \times t_m} = \frac{N}{W} \times 100\% \qquad (12)
$$

Industry Science and Engineering Vol. 1 No. 3, 2024

Therefore, using semantic segmentation position *p*, respictures

pictures for binocular vision ranging, the matching window

matching time can be reduced greatly.

5. **Contract Industry Science and Engineering Vol. 1 No. 3, 2024**

Therefore, using semantic segmentation position p, respectively, a

picturesfor binocular vision ranging, the matching window.

matching time can be reduced *Industry Science and Engineering Vol. 1 No. 3, 2024*

Therefore, using semantic segmentation position p , includes position contains time can be reduced greatly.
 5.1 Underwater Target Region Matching adaptive wind $($ **Industry Science and Engineering Vol. 1 No. 3, 2024**

Therefore, using semantic segmentation position p, respectures

for binocular vision ranging, the matching window.

matching time can be reduced greatly.
 5.1 Underw *Industry Science and Engineering Vol. 1 No*
Therefore, using semantic segmentatio
picturesfor binocular vision ranging, th
matching time can be reduced greatly.
5.1 Underwater Target Region Matchin
(ROI)
The energy f **Industry Science and Engineering Vol. 1 No. 3, 2024**

Therefore, using semantic segmentation pos

picturesfor binocular vision ranging, the mantching time can be reduced greatly. Ac
 5.1 Underwater Target Region Matchin *Industry Science and Engineering Vol. 1 No. 3, 2024*

Therefore, using semantic segmentation position p, respect

picturesfor binocular vision ranging, the matching window.

According to the te

5.1 **Underwater Target Re**

$$
E(D) = E_{data}(D) + \lambda E_{smooth}(D)
$$
 (13)

expression:

ence and Engineering Vol. 1 No. 3, 2024
\nusing semantic segmentation position *p*, respectively,
\nbinocular vision ranging, the
\ne can be reduced greatly. According to the texture
\n**after Target Region Matching** adaptive window size *W_i* be calculated. The followi
\nfunction is shown in Eq. (13) to
\nis energy function. That is, the
\narity is obtained.
\n=
$$
E_{data}(D) + \lambda E_{smooth}(D)
$$
 (13)
\nfunction has the following
\n $E_{ROI}(D) = \sum_{P \in ROI} C(P, D_P)$ (14)
\n+ $\sum_{q \in N_P \cap ROI} P_I[\lbrack D_p - D_q \rbrack = 1]$ (14)
\n+ $\sum_{q \in N_P \cap ROI} P_I[\lbrack D_p - D_q \rbrack = 1]$ (14)
\n+ $\sum_{q \in N_P \cap ROI} P_I[\lbrack D_p - D_q \rbrack = 1]$ (14)
\n**6.1 Experimental Environ
\nThe experiment uses a
\nunderwater shown as Fig
\nentire. The
\nconformment is Ubuntu
\nOn *CPCV*, python3.8.
\nThe process: Firstly, call**

nce and Engineering Vol. 1 No. 3, 2024

sing semantic segmentation prosition p, respectively,

innocular vision ranging, the matching window.

ter Target Region Matching and private matching window size W_i

be calcula 3.1 Underwater Target Region Matching

The energy function is shown in Eq. (13) to

the calculated. The follow

The energy function is shown in Eq. (13) to

the optimal disparity is obtained.
 $E(D) = E_{data}(D) + \lambda E_{smooth}(D)$ (13)
 Industry Science and Engineering Vol. 1 No. 3, 2024

Therefore, using semantic segmentation position p, respectively

pictures

For binocular vision ranging, the matching window.

According to the texture
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Therefore, using semantic segmentation pointing volume is expectively, a

Therefore, using smanning pointing into the texture spin expectively, a
 EXECUTE: Constraint term as the reduced greatly.
 EXECU optimal disparity is obtained.
 $E(D) = E_{data}(D) + \lambda E_{smooth}(D)$ (13)

The energy function has the following
 $E_{\kappa o}(D) = \sum_{r \in \mathcal{D}} C(P, D_r)$
 $\left.\frac{E_{\kappa o}(D)}{1 + \sum_{q \in \mathcal{N}_r \mid \kappa o} P_r} \right[|D_r - D_q| = 1]$ (14)
 $\left.\frac{E_{total}}{1 + \sum_{q \in \mathcal{N}_r \$ pixels, P_1 and P_2 are penalty coeffic + $\lambda E_{\text{smooth}}(D)$ (13)

has the following of adjustment of th
 $\sum_{k \in \mathbb{Z}} C(P, D_p)$
 6. Binocular Rang
 $\left[\begin{matrix} |D_p - D_q| = 1 \end{matrix}\right]$ (14)
 6.1 Experimental

is the disparity map, underwater shown

of the matching cost, e The energy function has the following

expression:
 $E_{R_{BO}}(D) = \sum_{P \in E(O)} P(P, D_{\rho})$ 6. Binocular Ranging
 $+\sum_{q \in N_{\rho} \cap R(O)} P_{\rho} |D_{\rho} - D_{q}| = 1$ (14)
 $+\sum_{q \in N_{\rho} \cap R(O)} P_{\rho} |D_{\rho} - D_{q}| = 1$ (14)
 $\sum_{q \in N_{\rho} \cap R(O)} P_{\rho} |D_{\rho}$ expression:
 $E_{ROI}(D) = \sum_{P \in R/I} (P, D_p)$
 $+ \sum_{q \in N_p \cap ROP} P_I[[D_p - D_q] = 1]$ (14)
 $+ \sum_{q \in N_p \cap ROP} P_I[[D_p - D_q] = 1]$ (14)
 $+ \sum_{q \in N_p \cap ROP} P_I[[D_p - D_q] = 1]$ (14)
 $+ \sum_{q \in N_p \cap ROP} P_I[[D_p - D_q] = 1]$ (14)
 $+ \sum_{q \in N_p \cap ROP} P_I[[D_p - D_q] = 1]$ (14)
 $E_{\text{non}}(D) = \sum_{P \in \text{non}}^{\infty} C(P, D_p)$ 6. Binocular Rangi
 $+ \sum_{q \in \mathbb{N}_p \setminus \{0,0\}} P_i \left[|D_p - D_q| = 1\right]$ (14)
 $+ \sum_{q \in \mathbb{N}_p \setminus \{0,0\}} P_i \left[|D_p - D_q| > 1\right]$ The experiment all

Among them, D is the disparity map, underwater sh $+\sum_{q \in N_r \cap [RO]} P_I[[D_p - D_q] = 1]$ (14)
 $+\sum_{q \in N_r \cap [RO]} P_I[[D_p - D_q] > 1]$ **6.1 Experimental Environ**

The experiment uses a

Among them, D is the disparity map, underwater shown as Figure
 $E_{\text{smooth}}(D)$ is the sum of the matching minimize this energy function. That is, the

optimal disparity is obtained.
 EQD $= E_{\text{data}}(D) + \lambda E_{\text{smooth}}(D)$ (13)

The energy function has the following
 $E_{\text{rot}}(D) = E_{\text{data}}(D) - \sum_{\substack{c} C} C(P, D_c)$
 $\sum_{\substack{c \in \mathbb{N} \\ c \neq c$ Among them, D is the disparity map, the experiment uses a
 $E_{\text{smooth}}(D)$ is the sum of the matching cost,
 $E_{\text{smooth}}(D)$ is the sum of the matching cost,
 $E_{\text{smooth}}(D)$ is the sum of the matching cost,
 $E_{\text{smooth}}(D)$ is the s Among them, D is the disparity map,
 $E_{\text{shac}}(D)$ is the sum of the matching cost,
 $E_{\text{smooth}}(D)$ is the smoothing constraint term as
 $E_{\text{smooth}}(D)$ is the smoothing constraint term as
 $E_{\text{smooth}}(D)$ is the smoothing cons $E_{data}(D)$ is the sum of the matching c
 $E_{smooth}(D)$ is the smoothing constraint term

the energy function, p and q represent

pixels, P_1 and P_2 are penalty coefficienc

C is the data constraint term, λ is a wei

para **EXERUTE 1200**
 EXERUTE 1200 the energy inction, p and q represent the
pixels, P_i and P_2 are penalty coefficient, internal and external pixels, P_i and P_2 are penalty coefficient, internal and extend there is a central pixel there is the pixels, P_1 and P_2 are penalty coencient,
 C is the data constraint term, λ is a weight

inhocular camera. The

inhocular camera, λ

inhocular camera. The

inhocular camera and the smoothing

term. ROI repres C is the data constraint leftm, λ is a weight
parameter, which is used to balance the
importance of the data term and the smoothing
term. ROI represents the set of pixels in the smoothing
underwater target area, $N_p \cap RO$ $E_{\text{dual}}(D)$ is the sum of the matching cost,
 $E_{\text{dmod}}(D)$ is the smoothing constraint term as
 $\sum_{\text{dmod}}(D)$ is the smoothing constraint term as
 $\sum_{\text{dmod}}(D)$ is the smoothing constraint term as
 $\sum_{\text{dmod}}(D)$ is pixels, P_i and P_2 are penalty coefficient, internal and external parameters of C is the data constraint term, λ is a weight
parameter, which is used to balance the simulation generated by the binocular came
impo C is the data constraint term, λ is a weight
piecture captured by the binocular camparameter, which is used to balance the seamatically segmented to obtain
importance of the data term and the smoothing
underwater trage

parameter, which is used to balance the

importance of the data term and the smoothing

term. ROI represents the set of pixels in the

underwater target area, $N_p \cap ROI$ represents

the set of pixels in the neighborhood of d central text of pixels in the central pixel point

the set of pixels in the neighborhood of distance of the Picturepoint *p* that are also located in the underwater target.

ROI area.

5.2 Adaptive Aggregation Window

Sup 5.2 Adaptive Aggregation Window
Suppose that there is a central pixel *i*, and the
set of surrounding pixels is denoted by N_i ,
which includes the central pixel and its
surrounding pixels. For each pixel point
 $j \in N_i$, t

$$
S_{ij} = \sum_{p \in w} (I_i(p) - I_j(p))^2
$$
 (15)

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Therefore, using semantic segmentation position p, respectively, and

interestion is shown in Eq. (13) to

the energy function is shown in Eq. (13) to

the energy funct **Industry Science and Engineering Vol. 1 No. 3, 2024**

Therefore, using semantic segmentation position p, respectively, i

pictures for binocular vision ranging, the matching window.

According to the texture
 5.1 Under py Science and Engineering Vol. 1 No. 3, 2024

Section 19 Section 1 *neering Vol. 1 No.* 3, 2024
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 6. Binocular Ranging Experiment
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 $W_i = \alpha \sqrt{\frac{1}{|N_i|} \sum_{j \in N_i} S_{ij}}$ (16)

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6. Binocular Ranging Experiment

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The experiment uses $W_i = \alpha \sqrt{|N_i|} \sum_{j \in N_i} S_{ij}$ (16)

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6. Binocular Ranging Experiment

6.1 Experimental Environment and Process

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6. Binocular Ranging Experiment
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The process: Firstly, calibrated the left and
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Figure 3. Binocularly corrected to measure the

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Figure 3. Binocular Camera

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Figure 3. Binocular Camera

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 6.3 Experimental Results and Analysis semantic segmentation pi

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 6.3 Experimental Results and Analysis semantic segmentatic

The above pictures are semantically segmented w Translation-vector $\frac{6.0039}{-6.0113}$
 S.8 Experimental Results and Analysis method of binocular

The above pictures are semantically segmented which realizes the acc

to generate a hybrid picture of underwater underw lines, as shown in Figure 5.

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References

- 13(3):129-140.
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- application not only expands the application
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References
[1] Ortiz A Simo M Oliver G. is the following the System of Semantic segmentation technology,
also provides a new solution to the ranging
plem in the field of marine engineering.
Frances
Critical Applications, 2002
13(3):129-140.
Li Zhen. Design a also provides a new solution to the ranging
plem in the field of marine engineering.
errences
Ortiz A Simo M Oliver G. A vision system
for an underwater cable tracker. Machine
Vision and Applications, 2002
13(3):129-140. been in the field of marine engineering.
 Shipsum China, Eventon China, 1910,

The China, 2010

The Vision and Applications, 2002

13(3):129-140.

Li Zhen. Design and research of automatic

tracking ROV for underwater pi 51(03):142-151. References

[1] Ortiz A Simo M Oliver G. A vision system

for an underwater cable tracker. Machine

Vision and Applications, 2002

13(3):129-140.

[2] Li Zhen. Design and research of automatic

tracking ROV for underwater
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Industry Science and Engineering Vol. 1 No. 3, 2024

Example 31 Exercise and Engineering Vol. 1 No. 3, 2024

Underwater Cable Automatic Recognition [8] Tang Xudong

Using Hough Transformation. Proceedings [8] Tang Xudong

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Underwater Cable Automatic Recognition [8] Tang Xudong

Using Hough Transformation. Proceedings pipeline detector

of IAPR Workshop on Machine Vision of intelligent
 Computer Science and Engineering Vol. 1 No. 3, 2024

Underwater Cable Automatic Recognition [8] Tang Xudong. Re

Using Hough Transformation. Proceedings pipeline detection a

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Underwater Cable Automatic Recognition [8] Tang Xudong. Researcl

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Underwater Cable Automatic Recognition

Using Hough Transformation. Proceedings

Applications, Kawasaki, Japan 1994.

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Underwater Cable Automatic Recognition

Using Hough Transformation. Proceedings

of IAPR Workshop on Machine Vision

Applications, Kawasaki, Japan. 1994.

2 Engineer **Example 19 Example 10 Set and Engineering Vol. 1 No. 3, 2024**

Underwater Cable Automatic Recognition

18] Tang Xudong. Res

Using Hough Transformation. Proceedings

18] Tang Xudong. Res

2013 Worley, Hu-Fu, Wan Lei, et a 46(02):178-183. **Industry Science and Engineering Vol. 1 No. 3, 2024**

Underwater Cable Automatic Recognition [8] Tang Xudong. Rese

Using Hough Transformation. Proceedings pipeline detection and

of IAPR Workshop on Machine Vision of in **Example 12 Science and Engineering Vol. 1 No. 3, 2024**

Underwater Cable Automatic Recognition [8] Tang Xudong. R.

Using Hough Transformation. Proceedings pipeline detection of IAPR Workshop on Machine Vision of intellig based on gradient information. Harbin (19) Califormation (8) Tang Xudong. New Using Hough Transformation. Proceedings of IAPR Workshop on Machine Vision of intelligent underpolications, Kawasaki, Japan.1994. Engineering Un Underwater Cable Automatic Recognition

Using Hough Transformation. Proceedings

of IAPR Workshop on Machine Vision

Applications, Kawasaki, Japan.1994.

Engineering University, 2016

Robotics Vision-Based System of Vision Using Hough Transformation. Proceedings

of IAPR Workshop on Machine Vision

of intelligent underwate

[5] Zeng Wen-jing, Xu Yu-ru, Wan Lei, et al. g.

[9] Balasuriya B, Takai N

Robotics Vision-Based System of Vision base of IAPR Workshop on Machine Vision

2011 Applications, Kawaaki, Japan.1994.

2013 Machine Ingineering University,

2013 Rabotics Vision-Based System of Vision based autonom

2018 Altai Mutonomous Underwater Vehicle for an Applications, Kawasaki, Japan. 1994.

2Ceng Wen-jing, Xu Yu-ru, Wan Lei, et al. g.

Robotics Vision-Based System of Nuion based autonomous Underwater Vehicle for an

2Cent Autonomous Underwater Vehicle for an Underwater Pi Example Men-Jing, Xu Yu-ru, Wan Lei, et al. g. [9] Balasuriya B, Tak

Robotics Vision-Based System of Vision based at

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Underwater Pipeline Tracker. Journal of S trac
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- Robotics Vision-Based System of Vision-Based System of Underwater Vehicle for an veh

Underwater Pipeline Tracker. Journal of S traa

hanghai Jiaotong University, 2012, Co

46(02):178-183. Ma

Li Shuangshuang. Research on

- [8] Tang Xudong. Research on underwater
pipeline detection and tracking technology
of intelligent underwater vehicle. Harbin
Engineering University, 2010, 12.
[9] Balasuriva B. Takai M. Lam W. et al. **Publishing House**
Tang Xudong. Research on underwater
pipeline detection and tracking technology
of intelligent underwater vehicle. Harbin
Engineering University, 2010, 12.
Balasuriya B, Takai M, Lam W, et al.
Vision base **Conserved Acceleric Education**

Tang Xudong. Research on underwater

pipeline detection and tracking technology

of intelligent underwater vehicle. Harbin

Engineering University, 2010, 12.

Balasuriya B, Takai M, Lam W, **Example 12 Academic Education**

Tang Xudong. Research on underwater

pipeline detection and tracking technology

of intelligent underwater vehicle. Harbin

Engineering University, 2010, 12.

Balasuriya B, Takai M, Lam W,
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Balasuriya B, Takai M, Lam W, et al.

Vision based autonomous underwater vehicle navigation: under Controllering Controllering Controllering Schools**

Tang Xudong. Research on underwater

pipeline detection and tracking technology

of intelligent underwater vehicle. Harbin

Engineering University, 2010, 12.

Balasuriya **Configured Control Control Publishing House**
Tang Xudong. Research on underwater
pipeline detection and tracking technology
of intelligent underwater vehicle. Harbin
Engineering University, 2010, 12.
Balasuriya B, Takai M **Conference Conference Conference Process**

Tang Xudong. Research on underwater

pipeline detection and tracking technology

of intelligent underwater vehicle. Harbin

Engineering University, 2010, 12.

Balasuriya B, Takai **Contract Control Control**
 Control Control C 1997:1418-1424. [8] Tang Xudong. Research on underwater
pipeline detection and tracking technology
of intelligent underwater vehicle. Harbin
Engineering University, 2010, 12.
[9] Balasuriya B, Takai M, Lam W, et al.
Vision based autonomo Tang Xudong. Research on underwater
pipeline detection and tracking technology
of intelligent underwater vehicle. Harbin
Engineering University, 2010, 12.
Balasuriya B, Takai M, Lam W, et al.
Vision based autonomous underw Tang Xudong. Research on underwater
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of intelligent underwater vehicle. Harbin
Engineering University, 2010, 12.
Balasuriya B, Takai M, Lam W, et al.
Vision based autonomous underw pipeline detection and tracking technology
of intelligent underwater vehicle. Harbin
Engineering University, 2010, 12.
Balasuriya B, Takai M, Lam W, et al.
Vision based autonomous underwater
vehicle navigation: underwater of intelligent underwater vehicle. Harbin
Engineering University, 2010, 12.
[9] Balasuriya B, Takai M, Lam W, et al.
Vision based autonomous underwater
vehicle navigation: underwater cable
tracking. OCEANS'97 MTS/IEEE
Conf Engineering University, 2010, 12.

Balasuriya B, Takai M, Lam W, et al.

Vision based autonomous underwater

vehicle navigation: underwater cable

tracking. OCEANS'97 MTS/IEEE

Conference Proceedings, Halifax Cannada:

Mar Balasuriya B, Takai M, Lam W, et al.
Vision based autonomous underwater
vehicle navigation: underwater cable
tracking. OCEANS'97 MTS/IEEE
Conference Proceedings, Halifax Cannada:
Marine Technology Society
1997:1418-1424.
C Vision based autonomous underwater
vehicle navigation: underwater cable
tracking. OCEANS'97 MTS/IEEE
Conference Proceedings, Halifax Cannada:
Marine Technology Society
1997:1418-1424.
Cai Sijing, Wang Yanyu. Improved
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