| Problem Chosen | 2025 | Team Control Number |
|:---:|:---:|:---:|
| **Y** | **MCM/ICM**<br>**Summary Sheet** | **1234567** |

# Input Your Article Title Here
# if it is too Long

### Summary

This is abstract.This section should describe what problem the paper solves, what methods are applied, what results are obtained and summarize them.

This is the second line abstract.And if you look carefully you can see that the spacing within and between paragraphs is different, which facilitates our reading in paragraphs.

This is **the special** `special` *special special* fonts in abstract.

**Keywords: Fighting Wildfires; Multi-Objective Optimization; Poisson Distribution; Tabu Search Algorithm; Sensitivity Analysis**

# Contents

# 1  Introduction

## 1.1  Problem Background



(a) Subfigure Name1(left)　　　　　　　　　(b) Subfigure Name2(right)

Figure 1: Figure Name

## 1.2  Restatement of the Problem

- Problem 1:
- Problem 2:
- Problem 3:
- Problem 4&5:



Figure 2: Flow Chart of this Paper's Research

# 2  Assumptions and Explanations

Considering ...

*Assumption* **1:** **We assume that ...**
　　　　　　　*Explanation:*...

*Assumption* **2:** **We assume that ...**
　　　　　　　*Explanation:*...

*Assumption* **3:** **We assume ...**
　　　　　　　*Explanation:*...

# 3　Notations

Some important mathematical notations used in this paper are listed in Table 1.

Table 1: Notations used in this paper

| Symbol | Description | Units |
|---|---|---|
| $\lambda_i$ | Meaning of the symbol | / |
| $y_i$ | Meaning of the symbol | / |
| $a_i$ | Meaning of the symbol | / |
| $\Delta R$ | Meaning of the symbol | / |
| $R^*$ | Meaning of the symbol | / |

*There are some variables that are not listed here and will be discussed in detail in each section.

# 4　Model Preparation

## 4.1　Data Overview

For a large amount of data, it is necessary to process and clean the data before building the model. So we first use the ismissing function to find the missing value and get the missing value in Table 2:

Table 2: Missing Data in Given Data

| Missing1 | Missing2 | Missing3 | Missing4 | Missing5 | Missing6 | Missing7 | Missing8 |
|---|---|---|---|---|---|---|---|
| Looooog | A | B | C | D | - | E | F |
| Word | A | B | C | D | - | E | F |
| | A | B | C | D | - | E | F |
| Multicolumn | These columns share common features | | | | | | |

### 4.1.1　Data Collection

And other data sources are shown in Table 3.

Table 3: Data and Database Websites

| Database Names | Database Websites |
|---|---|
| GDP of Each Country | https://ourworldindata.org/ |
| GDP of Some European Countries | https://data.worldbank.org/ |
| Partial Sailing Parameters | https://www.sailboat-cruising.com/ https://sailboatdata.com/ |

### 4.1.2 Data Screening

According to the data given, we...
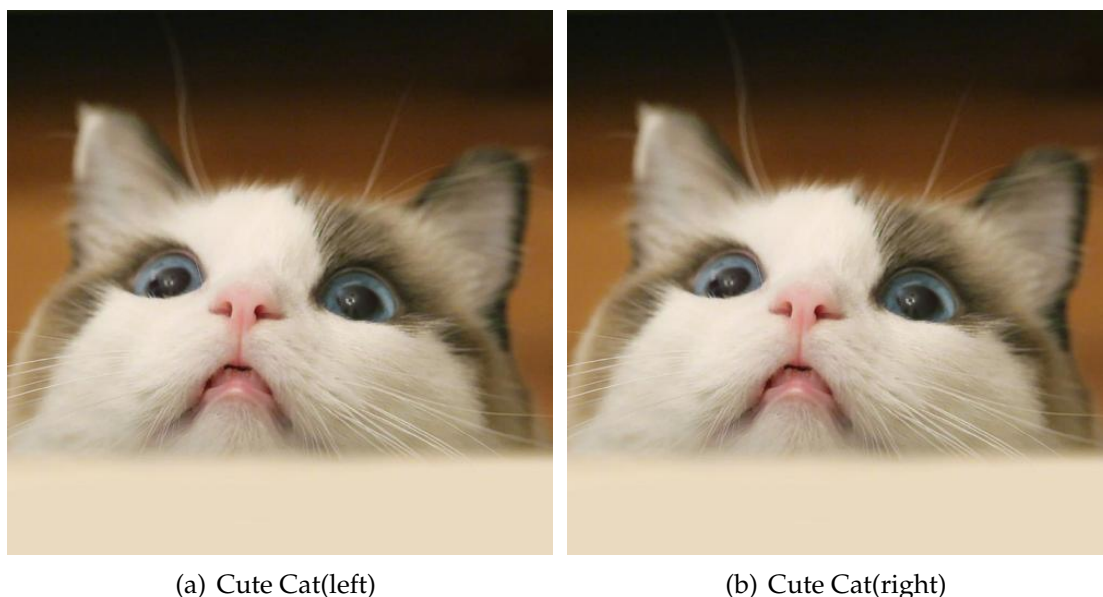


(a) Cute Cat(left)



(b) Cute Cat(right)

Figure 3: Data Screening

This is a double-table.

Table 4: Partial Monohull and Catamaran data

| AA | BB/$m$ | CC/m$^3$ | DD /m$^3$ | EE/m$^2$ | FF |
|---|---|---|---|---|---|
| A | B | C | D | E | F |
| A | B | C | D | E | F |
| AA | BB/$m$ | CC/m$^3$ | DD /m$^3$ | EE/m$^2$ | FF |
| A | B | C | D | E | F |
| A | B | C | D | E | F |

## 4.2 Detailed Parameter Analysis

To provide a comprehensive analysis of the model parameters, we present a detailed table that may span multiple pages if necessary.

Table 5: Detailed Parameter Analysis for Model Optimization

| Parameter | Type | Range | Default Value | Sensitivity |
|---|---|---|---|---|
| $\alpha$ | Continuous | [0, 1] | 0.5 | High |
| $\beta$ | Discrete | 1, 2, 3 | 2 | Medium |
| $\gamma$ | Continuous | [0.1, 0.9] | 0.7 | Low |
| $\delta$ | Continuous | [0.001, 0.1] | 0.01 | High |
| $\epsilon$ | Continuous | [0.0001, 0.1] | 0.001 | Medium |
| $\zeta$ | Discrete | 10, 20, 50 | 20 | Low |
| $\eta$ | Continuous | [0.05, 0.95] | 0.5 | High |
| $\theta$ | Continuous | [0.1, 0.9] | 0.3 | Medium |
| $\iota$ | Discrete | 5, 10, 15 | 10 | Low |
| $\kappa$ | Continuous | [0.01, 0.5] | 0.1 | High |
| $\lambda$ | Continuous | [0.001, 0.1] | 0.01 | Medium |
| $\mu$ | Continuous | [0.1, 0.9] | 0.5 | Low |
| $\nu$ | Continuous | [0.01, 0.5] | 0.1 | Medium |
| $\xi$ | Discrete | 1, 2, 3 | 2 | Low |
| $\pi$ | Continuous | [3.14, 3.15] | 3.1416 | High |
| $\rho$ | Continuous | [0.8, 0.99] | 0.9 | Medium |
| $\sigma$ | Continuous | [0.1, 1.0] | 0.5 | High |
| $\tau$ | Continuous | [0.01, 0.1] | 0.05 | Medium |
| $\upsilon$ | Discrete | 100, 200, 500 | 200 | Low |
| $\phi$ | Continuous | [0.2, 0.8] | 0.5 | High |
| $\chi$ | Continuous | [0.001, 0.1] | 0.01 | Medium |
| $\psi$ | Discrete | 2, 4, 8 | 4 | Low |
| $\omega$ | Continuous | [0.5, 2.0] | 1.0 | High |
| $\alpha_1$ | Continuous | [0.1, 0.9] | 0.5 | High |
| $\beta_1$ | Discrete | 2, 4, 6 | 4 | Medium |
| $\gamma_1$ | Continuous | [0.2, 0.8] | 0.5 | Low |
| $\delta_1$ | Continuous | [0.002, 0.02] | 0.01 | High |
| $\epsilon_1$ | Continuous | [0.0002, 0.02] | 0.002 | Medium |
| $\zeta_1$ | Discrete | 20, 40, 60 | 40 | Low |
| $\eta_1$ | Continuous | [0.1, 0.9] | 0.5 | High |
| $\theta_1$ | Continuous | [0.2, 0.8] | 0.5 | Medium |
| $\iota_1$ | Discrete | 10, 20, 30 | 20 | Low |
| $\kappa_1$ | Continuous | [0.02, 0.4] | 0.2 | High |
| $\lambda_1$ | Continuous | [0.002, 0.02] | 0.01 | Medium |
| $\mu_1$ | Continuous | [0.2, 0.8] | 0.5 | Low |
| $\nu_1$ | Continuous | [0.02, 0.4] | 0.2 | Medium |
| $\xi_1$ | Discrete | 2, 4, 6 | 4 | Low |
| $\rho_1$ | Continuous | [0.85, 0.95] | 0.9 | Medium |
| $\sigma_1$ | Continuous | [0.2, 0.8] | 0.5 | High |
| $\tau_1$ | Continuous | [0.02, 0.08] | 0.05 | Medium |
| $\upsilon_1$ | Discrete | 200, 400, 600 | 400 | Low |
| $\phi_1$ | Continuous | [0.3, 0.7] | 0.5 | High |
| $\chi_1$ | Continuous | [0.002, 0.02] | 0.01 | Medium |
| $\psi_1$ | Discrete | 4, 8, 12 | 8 | Low |
| $\omega_1$ | Continuous | [0.6, 1.8] | 1.2 | High |

Table 5 – Continued from previous page

| Parameter | Type | Range | Default Value | Sensitivity |
|---|---|---|---|---|
| $\alpha_2$ | Continuous | $[0.15, 0.85]$ | 0.5 | High |
| $\beta_2$ | Discrete | $3, 6, 9$ | 6 | Medium |
| $\gamma_2$ | Continuous | $[0.25, 0.75]$ | 0.5 | Low |
| $\delta_2$ | Continuous | $[0.003, 0.03]$ | 0.015 | High |
| $\epsilon_2$ | Continuous | $[0.0003, 0.03]$ | 0.003 | Medium |
| $\zeta_2$ | Discrete | $30, 60, 90$ | 60 | Low |
| $\eta_2$ | Continuous | $[0.15, 0.85]$ | 0.5 | High |
| $\theta_2$ | Continuous | $[0.25, 0.75]$ | 0.5 | Medium |
| $\iota_2$ | Discrete | $15, 30, 45$ | 30 | Low |
| $\kappa_2$ | Continuous | $[0.03, 0.45]$ | 0.3 | High |
| $\lambda_2$ | Continuous | $[0.003, 0.03]$ | 0.015 | Medium |
| $\mu_2$ | Continuous | $[0.25, 0.75]$ | 0.5 | Low |
| $\nu_2$ | Continuous | $[0.03, 0.45]$ | 0.3 | Medium |
| $\xi_2$ | Discrete | $3, 6, 9$ | 6 | Low |
| $\rho_2$ | Continuous | $[0.82, 0.92]$ | 0.87 | Medium |
| $\sigma_2$ | Continuous | $[0.25, 0.75]$ | 0.5 | High |
| $\tau_2$ | Continuous | $[0.025, 0.075]$ | 0.05 | Medium |
| $\upsilon_2$ | Discrete | $300, 600, 900$ | 600 | Low |
| $\phi_2$ | Continuous | $[0.35, 0.65]$ | 0.5 | High |
| $\chi_2$ | Continuous | $[0.003, 0.03]$ | 0.015 | Medium |
| $\psi_2$ | Discrete | $6, 12, 18$ | 12 | Low |
| $\omega_2$ | Continuous | $[0.7, 1.6]$ | 1.4 | High |

This comprehensive parameter analysis provides the foundation for our model optimization process. The table is designed to span multiple pages if needed, ensuring readability and accessibility of all parameter information.

# 5 Layout of Formulas, Graphs and Tables

## 5.1 Layout of Formulas

We can use the following codes to describe a part of calculation.

**1.** A complex line of formulas…

$$C = \begin{bmatrix} Cov\,(x_1, x_1) & Cov\,(x_1, x_2) \\ Cov\,(x_2, x_1) & Cov\,(x_2, x_2) \end{bmatrix}, \text{ where } Cov\,(x_2, x_1) = \frac{\sum_{i=1}^{M} (x_1^i - \overline{x_1})^2}{M - 1} \tag{1}$$

A description of the formula…

**2.** A complex line of formulas…

$$\begin{bmatrix} y_1^i \\ y_2^i \\ \vdots \\ y_k^i \end{bmatrix} = \begin{bmatrix} u_1^T & \cdots & (x_1^i, x_2^i, x_3^i, \cdots, x_N^i)^T \\ u_2^T & \cdots & (x_1^i, x_2^i, x_3^i \cdots, x_N^i)^T \\ \vdots & \cdots & \vdots \\ u_k^T & \cdots & (x_1^i, x_2^i, x_3^i, \cdots, x_N^i)^T \end{bmatrix} \tag{2}$$

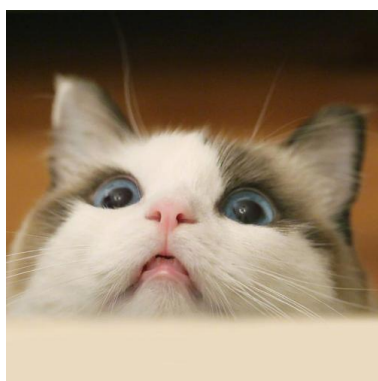A description of the formula...

**3.** A complex line of formulas...

$$Con = \frac{\lambda_i}{\sum_{k=1}^{p} \lambda_k}, \ (i = 1, 2, \cdots, p) \tag{3}$$

$$Con^* = \frac{\sum_{k=1}^{i} \lambda_k}{\sum_{k=1}^{p} \lambda_k}, \ (i = 1, 2, \cdots, p) \tag{4}$$
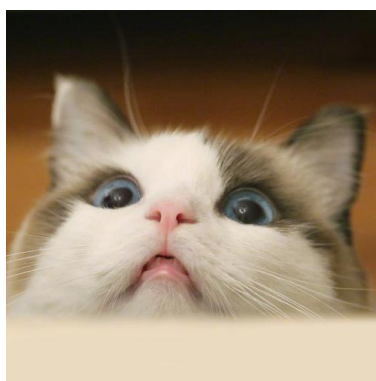
$$\frac{\mathrm{d}x}{\mathrm{d}y} = \frac{\mathrm{d}x}{\mathrm{d}z}\frac{\mathrm{d}z}{\mathrm{d}y}$$

A description of the formula....The Eq (1) is important.

## 5.2　Layout of Figures



(a) Subfigure1　　　　　　(b) Subfigure2　　　　　　(c) Subfigure3
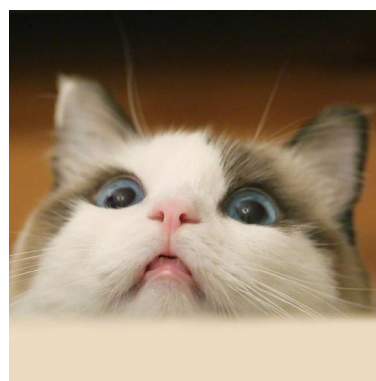
Figure 4: Subfigures



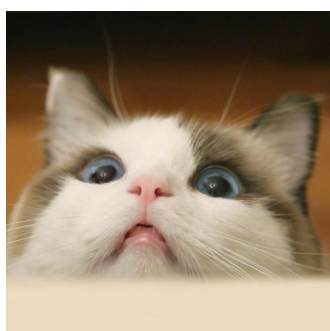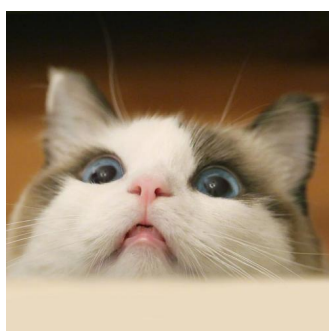Figure 5: Left Figure　　　Figure 6: Middle Figure　　　Figure 7: Right Figure
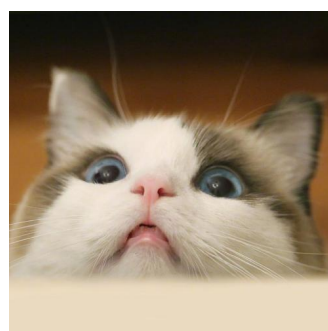
If we use complex algorithms, we need to illustrate them using pseudo-code.

---

**Algorithm 1:** CAT Fusion Pseudo-code

---

**Input:** BIG CATS

**Output:** LITTLE CATS

1　*Definition: $J = Inf$ & Create $a_{right}$ matrix to record the values of $a_1$, $a_2$ and $a_3$;*

2　**for** $a_3 = 0 to 1 (step = 0.01)$ **do**

3　　Define the objective function:

　　　$f(a_1) = \min \left\{ \sum (y - (a_1 x_1 + (1 - a_3 - a_2) x_2 + a_3 x_3))^2 \right\}$;

4　　Using function fmincon, solve the optimization problem;

5　　When the solution is complete, return the resulting $a_1$ and $f(a_1)$;

6　　**if** $f(a_1) < J$ **then**

7　　　　$J < - - f(a_1)$;

8　　　　Update $a_{right}$ matrix;

9　　**end**

10　**end**

---

## 5.3　Layout of Special Tables

Table 6: Cute Creatures

| Cute Creatures on Earth | | | |
|---|---|---|---|
| CAT | CAT | CAT | CAT |
| Cat | Cat | Cat | Fat Cat |
| Cat | Cat | Cat | Cat |
| Cat | Cat | Cat | Cat |
| Cat | Cat | Cat | Cat |

# 6　Conclusions and Interesting Information

...

## 6.1　Useful and Meaningful Conclusions

- As we can see...
- As we can see...
- As we can see...

# 7　Sensitivity Analysis

...

# 8 Model Evaluation and Further Discussion

## 8.1 Strengths

## 8.2 Weaknesses &Further Discussion

# 9 Conclusion

The cites[1][2][3][4][5]

# References

[1] GLOBAL FOREST WHATCH OF AUSTRALIA
https://www.globalforestwatch.org/topics/fires/?topic=fires#footer

[2] HU Teng, LIU Zhanjun, LIU Yang, et al. 3D reconnaissance path planning of multiple UAVs. Journal of Systems Engineering and Electronics, 2019, 41(7): 1551-1559.

[3] BASBOUS B. 2D UAV path planning with radar threatening areas using simulated an-nealing algorithm for event detection. The 2018 International Conference on Artificial Intelligence and Data Processing. Malatya, Turkey: IEEE,2018: 1-7.

[4] WANG W F, WU Y C, ZHANG X. Research of the unit decomposing traversal method based on grid method of the mobile robot. Techniques of Automation and Applications, 2013, 32(11): 34-38.

[5] XU Jian, ZHOU Deyun, HUANG He. Multi UAV path planning based on improved ge-netic algorithm. Aeronautical Computing Technique, 2009, 39(4): 43-46.

# A First Section

**Listing A.1: My 1st Code(Written by MATLAB)**

```matlab
% a comment
clear all, clc
% a comment
x = [1.00; 1.00; 1.00];
beta0 = [1 1 1];
modelfun = 'y ~ k*x^2+b'
mdl = fitnlm(tb,modelfun,beta0)
% a comment
plotResiduals(md1,'fitt111111111111111ed')
%this is so so so so so so so so so so so so so so so so so so so so
    so so so so so so so long code
```

```
29
30
31  %1
32  111
```

**Listing A.2: My 2st Code**

```
1  disp('hello')
```

**Listing A.3: My 2st Code**

```
1      disp('hello')
```

# B   Python Code Examples

## B.1   Basic Python Example

**Listing B.1: Simple Python Function**

```
1  # Python
2  def fibonacci(n):
3      """"""
4      if n <= 1:
5          return n
6      else:
7          return fibonacci(n-1) + fibonacci(n-2)
8
9  #
10 for i in range(10):
11     print(f"Fibonacci({i}) = {fibonacci(i)}")
```

## B.2   Data Analysis with Python

**Listing B.2: Data Processing Example**

```
1  import numpy as np
2  import pandas as pd
3  import matplotlib.pyplot as plt
4
5  #
6  data = {
7      'x': np.linspace(0, 10, 100),
8      'y': np.sin(np.linspace(0, 10, 100))
9  }
10 df = pd.DataFrame(data)
11
12 #
```

```
13  print(":")
14  print(df.describe())
15
16  plt.figure(figsize=(10, 6))
17  plt.plot(df['x'], df['y'], 'b-', linewidth=2)
18  plt.title('')
19  plt.xlabel('x')
20  plt.ylabel('sin(x)')
21  plt.grid(True)
22  plt.show()
```

# C   Use of AI

This section documents the interactions between the author and AI assistant during the development of this MCM/ICM paper. The conversations are presented in a question-and-answer format to demonstrate how AI was utilized for various aspects of the research.

## C.1   Model Development Assistance

**Question: How to optimize the UAV path planning algorithm?**

I'm working on a UAV path planning algorithm for wildfire monitoring. The current approach uses a grid-based method, but I'm encountering issues with computational efficiency when scaling to larger areas. What optimization techniques would you recommend?

**AI Response**

For UAV path planning optimization in wildfire scenarios, consider these approaches:
1. **Hybrid algorithms**: Combine genetic algorithms with simulated annealing for better convergence 2. **Multi-resolution grids**: Use coarse grids for initial planning, then refine locally 3. **Dynamic programming**: Implement Dijkstra's algorithm with priority queues 4. **Parallel processing**: Divide the search space for concurrent computation
The key is to balance exploration and exploitation while considering real-time constraints.

## C.2   Data Processing and Analysis

**Question: Data preprocessing for wildfire detection**

I have satellite imagery data for wildfire detection, but there's significant noise and missing values. What preprocessing steps should I implement before applying machine learning models?

---

**AI Response**

Recommended preprocessing pipeline:
- **Missing data**: Use interpolation or k-nearest neighbors imputation
- **Noise reduction**: Apply Gaussian or median filters
- **Normalization**: Scale pixel values to [0,1] range
- **Feature extraction**: Consider texture features, thermal gradients
- **Data augmentation**: Rotate, flip, and scale images for robustness

Also, implement cross-validation to ensure model generalization.

## C.3 Mathematical Formulation Assistance

**Question: Mathematical modeling for fire spread prediction**

I need to develop a mathematical model for wildfire spread prediction. What are the key factors and equations I should consider?

**AI Response**

Key factors for wildfire spread modeling:

$$\frac{\partial T}{\partial t} = \alpha \nabla^2 T + Q \quad \text{(Heat equation with source)}$$

$$\frac{\partial m}{\partial t} = -km \quad \text{(Fuel consumption)}$$

Where:
- $T$: Temperature distribution
- $m$: Fuel mass density
- $\alpha$: Thermal diffusivity
- $Q$: Heat generation rate
- $k$: Combustion rate constant

Consider wind effects, topography, and fuel moisture content as additional parameters.

## C.4 Code Implementation Support

**Question: MATLAB implementation for data visualization**

I need to create effective visualizations for wildfire data analysis in MATLAB. What plotting techniques and functions would you recommend?

---

**AI Response**

For wildfire data visualization in MATLAB:

```matlab
% Heat map for temperature distribution
heatmap(temperatureData, 'Colormap', hot);

% Time series for fire progression
plot(time, fireArea, 'r-', 'LineWidth', 2);

% 3D surface for terrain and fire spread
surf(X, Y, elevation, fireIntensity);

% Geographic plotting with mapping toolbox
geoplot(lat, lon, 'r-', 'LineWidth', 2);
```

Use subplot for multi-panel figures and customize colormaps for better interpretation.

## C.5 Conclusion on AI Usage

The AI assistant provided valuable support in algorithm optimization, data preprocessing guidance, mathematical formulation, and code implementation. All final decisions, analysis, and interpretations were made by the human author, with AI serving as a collaborative tool for brainstorming and technical guidance.