AI Empowered Soaring Trajectory Planning – Next Gen Green Aviation Solution

Presented by Albatross_NWPU

2024.10.05

Research Background

Green Aviation, New direction for aviation industry

- The development of aviation industry has brought about significant environmental and social impacts
- Many countries are actively responding to the environmental challenges brought about by aviation development
- Green aviation is frequently mentioned

Horizon Europe Work Programs

14th Five-Year Plan for the Green Development of Civil Aviation

Research Background

★ Key Problem:

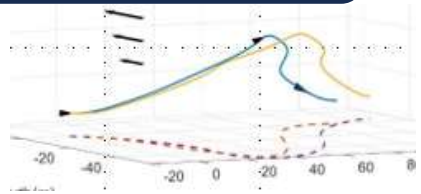
Green aviation is not well defined




Leading to

Difficult to analyze pain points

Energy?



Trajectory optimization?

Hard to point out solutions

★ Solutions:

Questionnaire

Green Aviation Global Survey

Awareness | Knowledge | Empowerment | Change

Data analyze

Pain

Energy **Aircraft Design** • • •

Solutions

Artificial Intelligence

Method

Questionnaire Info

Proposed by:

International Association for Green Aviation

西北工業大學 NORTHWESTERN POLYTECHNICAL UNIVERSITY

Powered by:

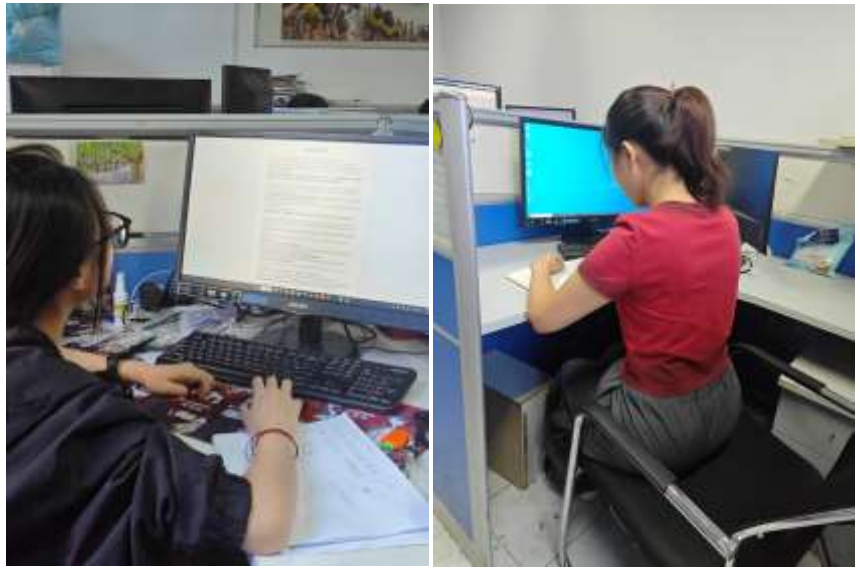
SurveyPluto 问卷星 -wjx.cn-

Advantages:

- Quantitative and qualitative data
- Standardized question design
- Large sample

Data Collection

Offline interview



Online interview

Dear Prof. Luo

I hope this mail finds you well. I am working on the project about the green aviation. I would like to invite you to have a quick survey, thank you!

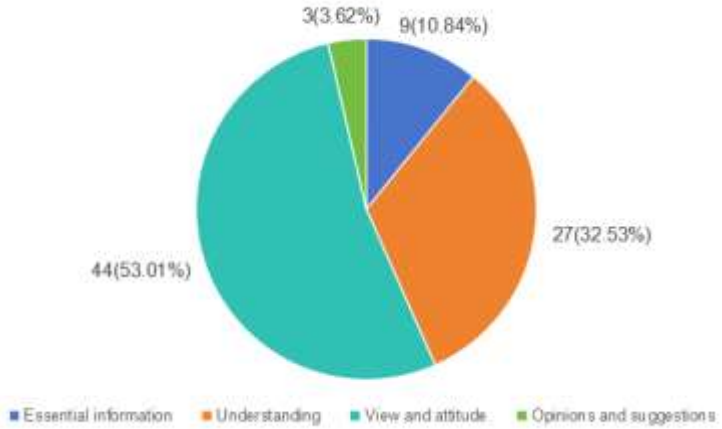
The link is shown as:

https://www.wjx.cn/vm/YdkOVJL.aspx

Best wishes,

Wei Wang

Question



Basic Info Collection

↓

Understanding Level

↓

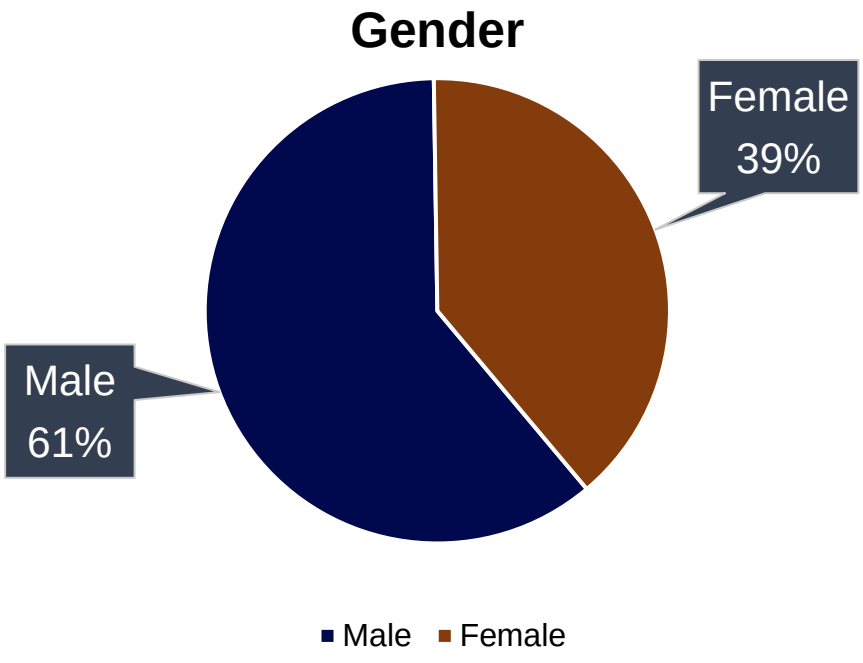
Opinion and Attitude

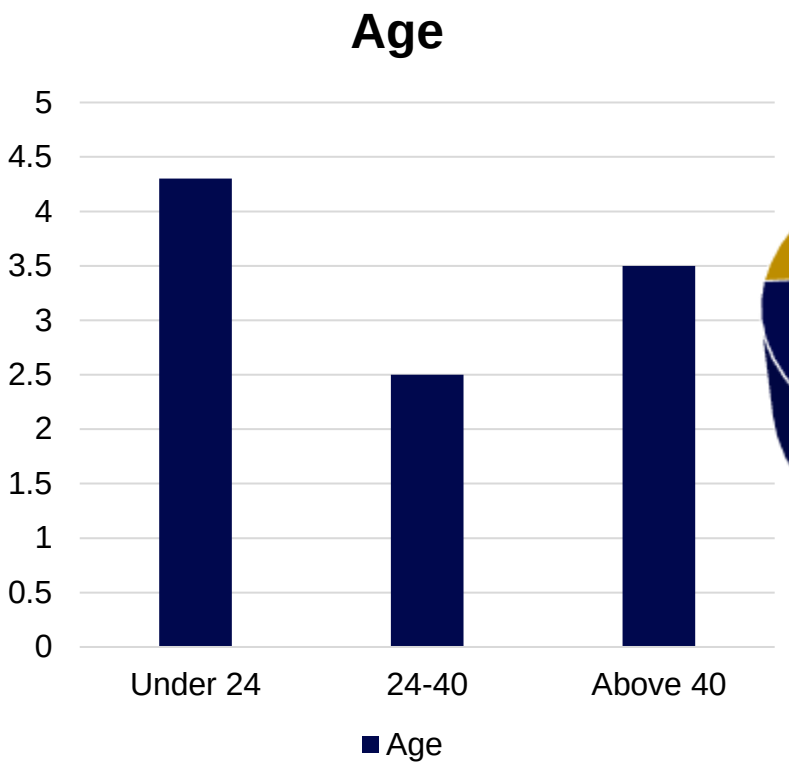
↓

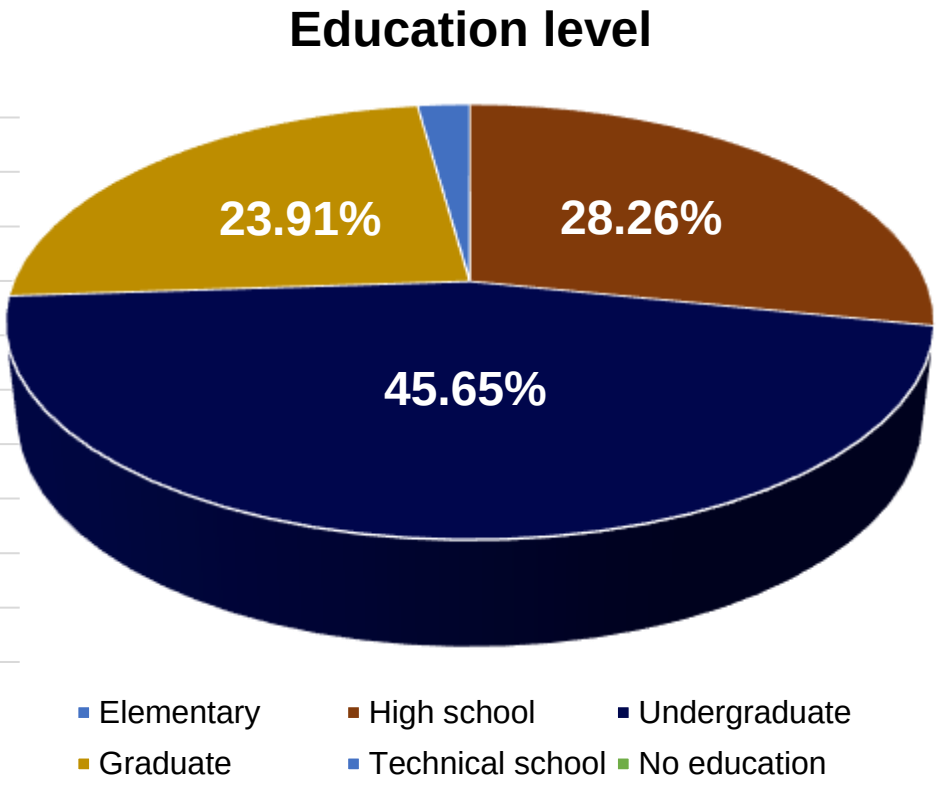
Comments and Suggestions

Results

Participants information



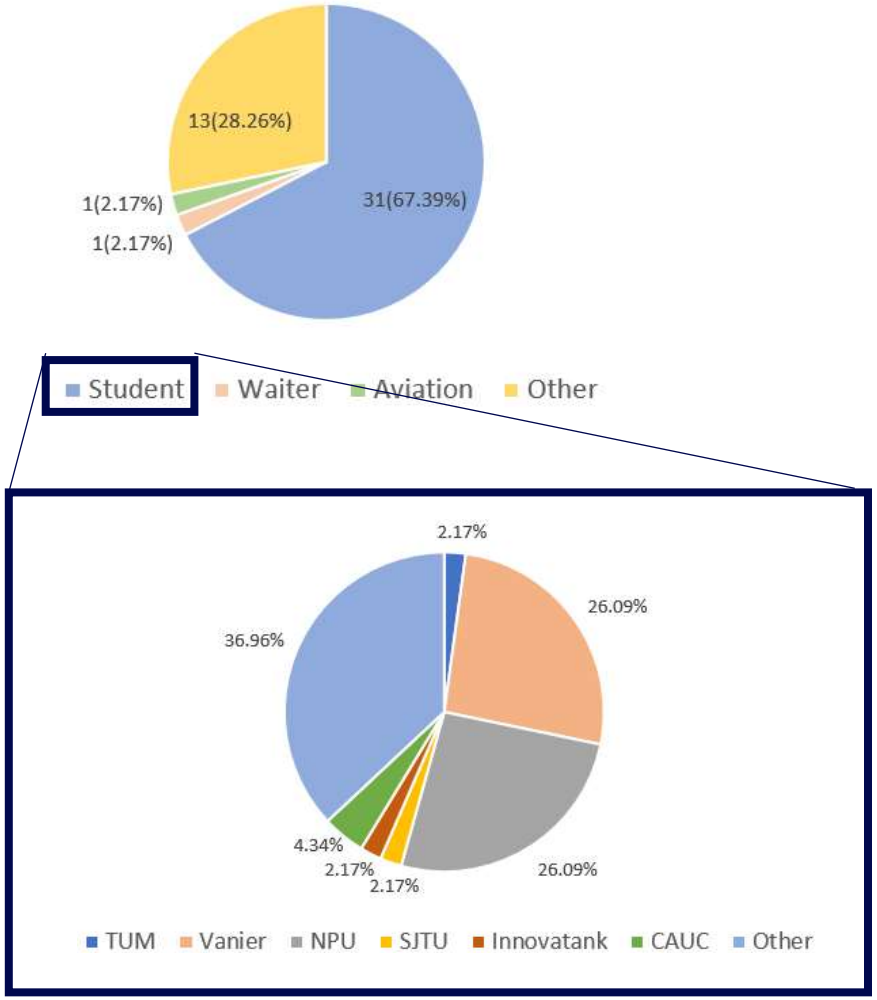




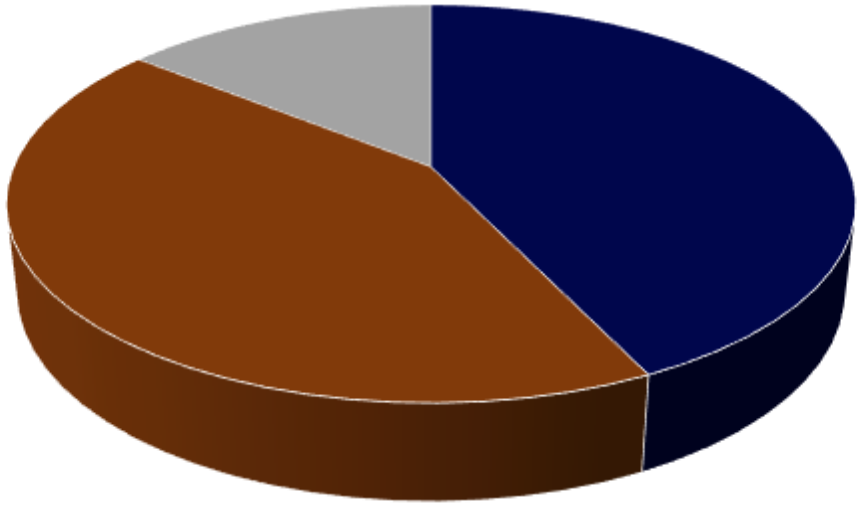
- The teenage male undergraduate student is the major part of this interview
- Students are well educated, and are active in thinking

Results

Participants information



Education level



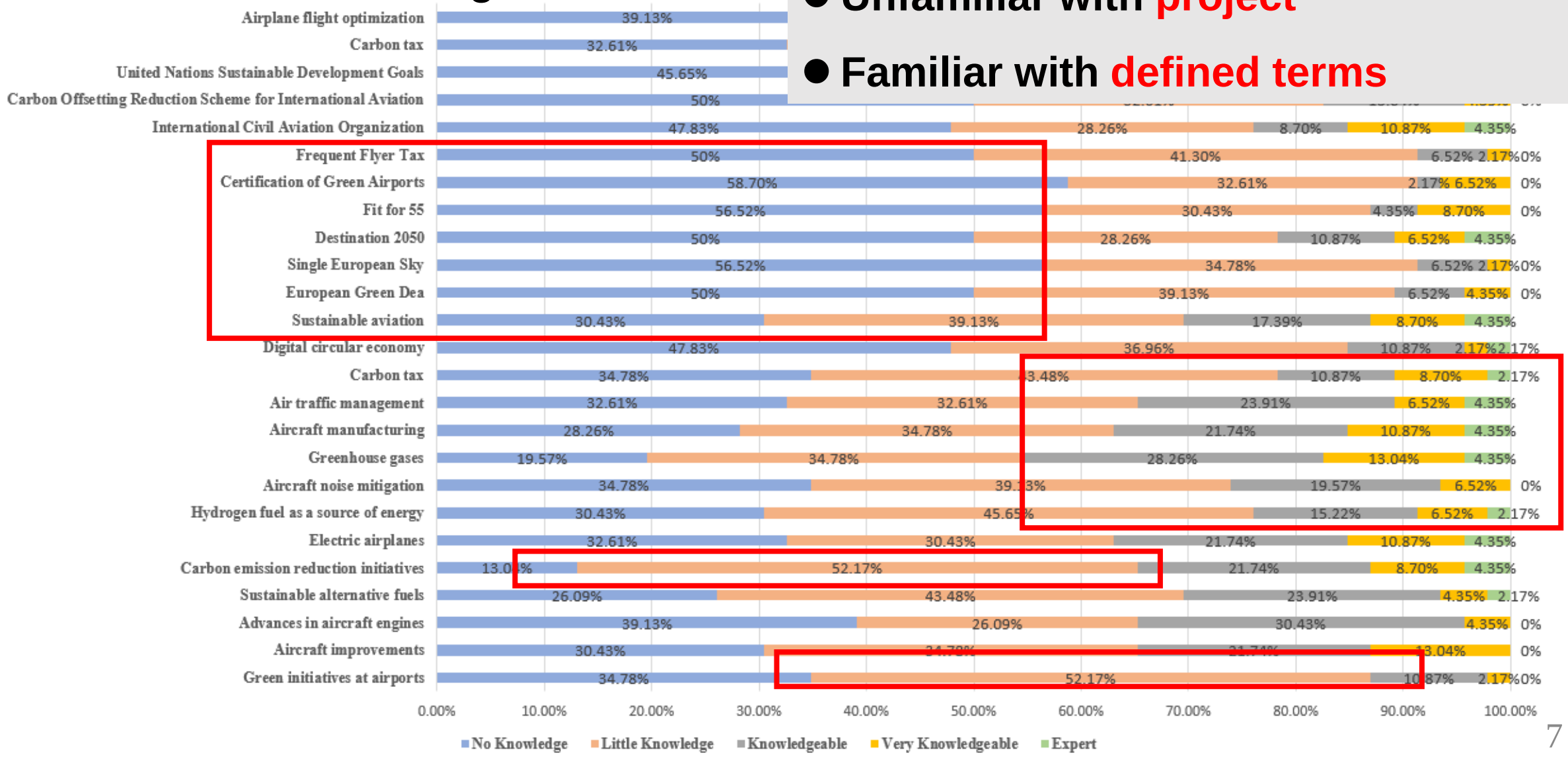
■ Undergraduate ■ Graduate ■ Ph.D. candidate

- The number of students is as high as 31
- Most of the students are from Northwestern Polytechnical University

Results

Green aviation knowledge

- Unfamiliar with project
- Familiar with defined terms



Results

Views on green aviation

- Strong Support for green aviation
- Want know more about green aviation
- Wavering about contributing to green aviation

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I feel that Green Aviation Initiatives will deliver on its promises for climate goals.	13.04%	41.30%	41.30%	4.35%	0%
I am confident that Green Aviation Initiatives are to the best of my interests.	17.39%	45.65%	28.26%	6.52%	2.17%
I trust Green Aviation in meeting climate goals.	17.39%	45.65%	34.78%	2.17%	0%
I trust that aviation organizations will do the right thing to meet climate goals.	26.09%	30.43%	34.78%	6.52%	2.17%
Participating in Green Aviation Initiatives can improve my performance at work.	13.04%	28.26%	50%	4.35%	4.35%
Participating in Green Aviation Initiatives can improve my career prospects.	10.87%	34.78%	39.13%	4.35%	2.17%
Green Aviation Initiatives are useful to my work.	13.04%	32.61%	32.61%	15.22%	6.52%
Green Aviation Initiatives are good for climate change.	45.65%	39.13%	15.22%	0%	0%
Participating in Green Aviation Initiatives would be beneficial to me	23.91%	43.48%	28.26%	2.17%	2.17%
Everyone should participate in Green Aviation Initiatives	23.91%	41.30%	30.43%	2.17%	2.17%
I intend to participate in Green Aviation Initiatives as frequently as possible	17.39%	32.61%	36.96%	10.87%	2.17%
I intend to maximize the utility of what I know about Green Aviation Initiatives	23.91%	36.96%	34.78%	0%	4.35%
I intend to learn more about Green Aviation Initiatives	30.43%	45.65%	17.39%	2.17%	4.35%
I intend to integrate Green Aviation Initiatives in my organization.	23.91%	23.91%	41.30%	4.35%	6.52%
I intend to further educate myself about Green Aviation	32.61%	39.13%	23.91%	4.35%	0%
I intend to take a course/training on Green Aviation, if it were available.	19.57%	21.74%	43.48%	8.70%	6.52%
Colleagues who influence my behavior think that I should participate in Green Aviation Initiatives.	17.39%	26.09%	39.13%	6.52%	10.87%
Colleagues who are important to me think that I should participate in Green Aviation Initiatives.	17.39%	15.22%	54.35%	2.17%	10.87%
Friends encourage me to participate in Green Aviation Initiatives	15.22%	17.39%	41.30%	17.39%	8.70%
Relatives encourage me to get involved in Green Aviation Initiatives	15.22%	15.22%	47.83%	13.04%	8.70%
I feel confident with my knowledge about Green Aviation.	13.04%	15.22%	28.26%	28.26%	15.22%
I feel confident in using what I have learned to engage in Green Aviation Initiatives	19.57%	19.57%	43.48%	6.52%	10.87%
I feel confident in my abilities to solve Green Aviation challenges.	17.39%	19.57%	34.78%	15.22%	13.04%
In general, information about Green Aviation Initiatives is not adequate	13.04%	21.74%	54.35%	4.35%	6.52%
Sufficient information about Green Aviation Initiatives is available to me in my work	17.39%	21.74%	36.96%	13.04%	10.87%
I feel that content related to Green Aviation is scarce.	10.87%	23.91%	47.83%	13.04%	4.35%
I feel that content related to Green Aviation is all over the place and difficult to find	10.87%	23.91%	45.65%	17.39%	2.17%
I feel that content related to Green Aviation is not up to date	8.70%	17.39%	58.70%	13.04%	2.17%
I feel that content related to Green Aviation is not easy to understand	13.04%	23.91%	47.83%	15.22%	0%
I have no difficulty explaining to others about what I know about Green Aviation.	10.87%	21.74%	36.96%	23.91%	6.52%
The results of my participation in Green Aviation Initiatives are apparent to me	13.04%	23.91%	54.35%	4.35%	4.35%
I see and understand the impact of Green Aviation Initiatives on the climate	19.57%	39.13%	36.96%	4.35%	0%
People in my organization who participate in Green Aviation Initiatives have more prestige than those who do not	10.87%	8.70%	60.87%	15.22%	4.35%
I feel that participating in Green Aviation improves the image of my organization.	17.39%	26.09%	52.17%	4.35%	0%
I feel that participating in Green Aviation improves my career prospects	10.87%	26.09%	56.52%	4.35%	2.17%
I feel that there are unequal power relations embedded in the structure of the Green Aviation movement.	4.35%	6.52%	76.09%	10.87%	2.17%
The concept of Green Aviation is not well understood.	8.70%	45.65%	32.61%	8.70%	4.35%
The lack of understanding of Green Aviation is clearly felt by my colleagues.	6.52%	32.61%	50%	4.35%	6.52%
In general, I feel that the outcomes of Green Aviation are not equally agreed upon between my colleagues.	6.52%	19.57%	63.04%	10.87%	0%
I feel constrained in participating in Green Aviation Initiatives	6.52%	4.35%	69.57%	17.39%	2.17%
I feel that my capabilities regarding the greening of aviation are not acknowledged.	4.35%	2.17%	78.26%	10.87%	4.35%
Knowledge of Green Aviation capability is not recognized	8.70%	15.22%	60.87%	10.87%	4.35%

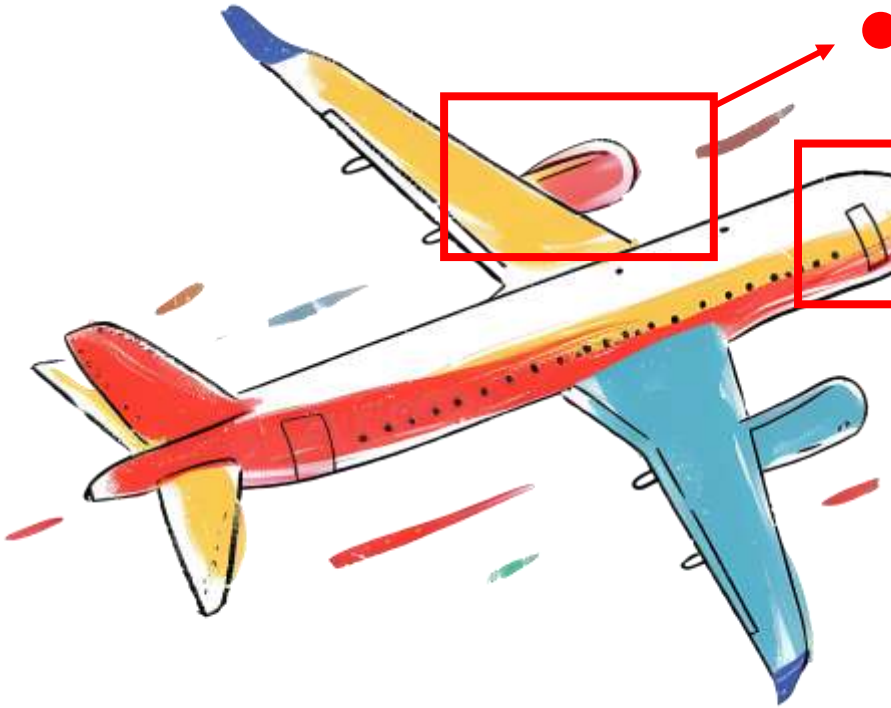
Discussion

Definition of Green Aviation

Energy

Sustainable | **Optimal** | **Clean**

Summary of Pain Points



- Price raises
- Human resource raises
- Policy restriction
- Cooperation difficulties

Major Pain Points →

Lack of method for utilizing new energy sources

Discussion

Solution

AI empowered trajectory planning to use wind

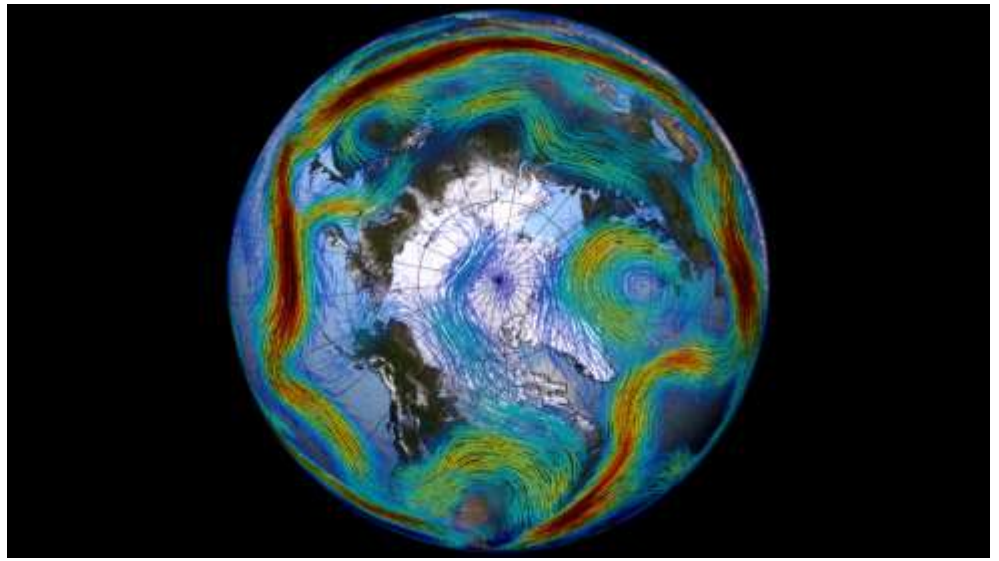
Albatross uses horizontal winds

Eagles use thermal updrafts

Rely on wind field

Rely on trajectory

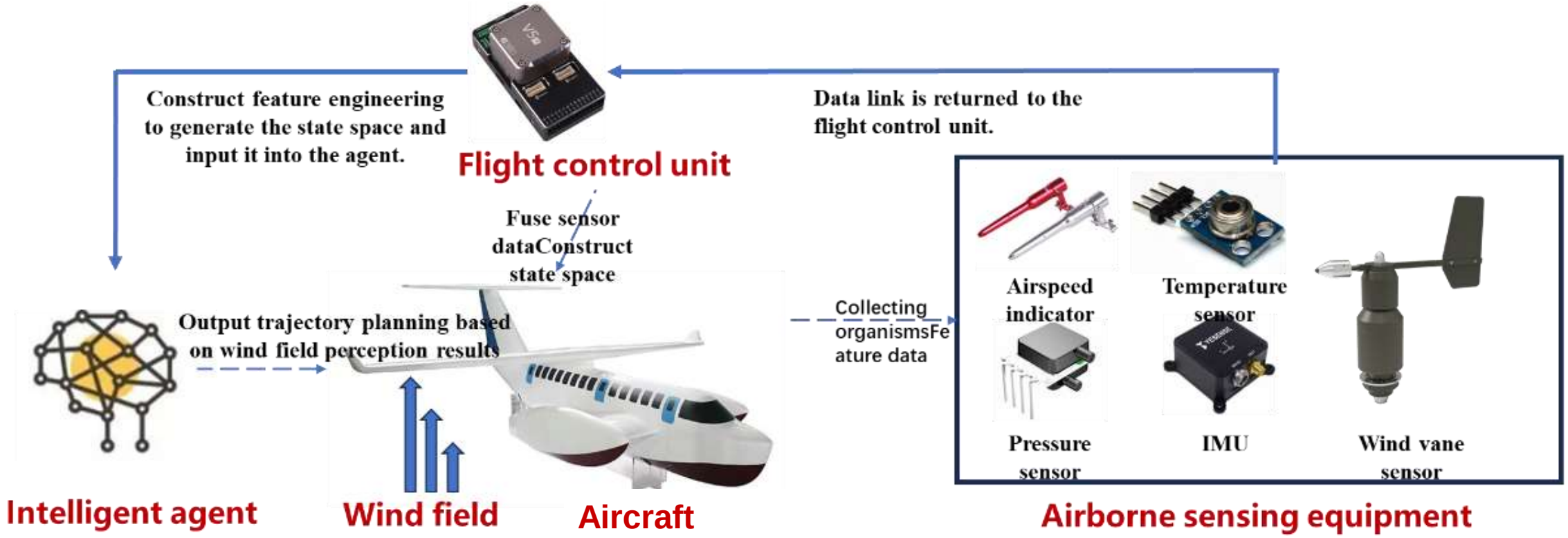
- Inspired by **birds**
- **Jet stream** is clean & sustainable
- **Trajectory** is key to use jet stream



Solution Road Map

Aims: Train aircraft to automatically plan energy gaining trajectory

Advantages: Increased Energy Efficiency; Reduced Greenhouse Gas Emissions



Cost analysis-research and development cost

	Content	Expense	Period
3D wind field data collection system	High-performance sensors, remote sensing equipment, and related software	2 millions of RMB	1 to 2 years
Reinforcement learning model	High-performance computing resources (GPU clusters) and AI development team	100 thousands of RMB	1 to 2 years
Experimental validation	Renting/building flight experimental equipment and testing environments	10 millions of RMB	1 to 2 years

Cost analysis-production cost

	Content	Expense	Period
System hard-ware production	Construct an automated production line	5 million of RMB	1-2 years
Raw material procurement	The required hardware components depend on market prices and procurement quantities	4 million RMB	Months
Labor costs	Wages paid to operators and technicians	8 million RMB	Ongoing

Cost analysis-operating and maintenance cost

	Expense	Period
Maintenance of wind field data system	Millions RMB	Once a year
Software system maintenance	Millions RMB	On-demand

Benefit Analysis

Fuel Cost Saving

Extended Equipment Lifespan

Policy Support

Conclusions

Aim

- **Achieve green aviation**

What is green aviation?

Aircraft is operating in the

- **Sustainable**
- **Optima**
- **Clean**

condition

How to achieve?

AI-based wind energy harvesting trajectory planning

- **Reduce carbon emissions**
- **High energy efficiency**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Thank you!