## Elevator Pitch

Our innovation, **SFTW (Self-Guided Filter TransWeather)**, is currently the most effective restoration model available, specifically designed to overcome adverse weather conditions on input. It uses advanced transformer base, a new-added self-guided-filtering layer, with real-time video processing capabilities, SFTW restores weather-degraded images to pristine clarity under ALL possible extreme conditions.

The impact of SFTW will extend across industries. For **autonomous-vehicles**, it will ensure reliable navigation by enhancing sensor visibility under challenging weather. For **AR/VR devices** like Vision Pro, it significantly improves user experience by restoring clarity on the cameras. **Drones and surveillance-systems** benefit from the extended live-video functionality, while **personal users** can now enjoy the freedom of aerial-photography, anywhere+everywhere.

BY 2030, the market for autonomous technologies, AV industries, are projected $2.1 trillion. SFTW has massive business potential to become the standard for weather-degraded image restoration. Practical, strong, and revolutionary- SFTW is the future of tools ensuring safety of computer vision technology.

## Team

1. **Formation**

Our team formed after a friend's drone crashed while capturing images of Guizhou Province under heavy mist. This incident reflected the challenges of weather for computer-vision, inspiring us to develop technology to overcome such issues. Our skills and passion for innovation+entrepreneurship drove us to create specialized-software.

**2. Member Roles**

* **Lifu Zhang**: CEO+CTO, Leading technological innovations and running the company. (45% equity)
* **Claire Xu**: CFO, Analyzing profit and competition (30% equity)
* **Richard Li**: CMO, Analyzing strategies to sell our product and compete. (25% equity)

1. **Motivation(brief)**

Our concern for the future motivated us. CV is widely integrated into our lives, and AI is used in applications that directly affects human-lives. Adverse weather could mislead AI’s ability to make accurate decisions, such as detecting a victim or surrounding dangers, risking the safety of all. This inspired us to enhance image restoration techniques to improve AI decision-making accuracy in critical scenarios.

## Opportunity

The primary issue that the SFTW model addresses is the degradation of image quality under adverse weather conditions, which are significant challenges to CV algorithms that rely on precise and accurate visual inputs to function effectively and safely. In industries such as autonomous driving, surveillance, satellite imaging, environmental monitoring, and drone photography, it would have to have a constant clear input to ensure product reliability and safety. Adverse weather conditions, including heavy rain, fog, haze, and snow are prevalent, causing severe image degradation by blurring, reducing feature clarity, lowering contrast, adding noise+artifacts, and blocking key visual elements. This can cause inaccurate data interpretation, with serious consequences, especially in critical applications like autonomous driving, where safety should be guaranteed, or in surveillance, where cameras may fail to capture suspects’ features.

Current image restoration models are not ready to resolve these challenges practically. Many are weather-specific, requiring multiple models for different weather conditions, which increases computational requirements and complexity and wastes time on training. Furthermore, no existing models can process videos or live streams, limiting their practicality in real-world applications. For example, autonomous vehicles and surveillance systems rely on continuous data inputs for immediate decision-making, where delays or inaccuracies due to image degradation can lead to failures.

SFTW directly resolves these by providing an all-in-one solution to restore image quality across various weather conditions, including mixed scenarios, with a single model. Unlike traditional methods, the SFTW model has a real-time processing capability, making it the first model existing to restore dynamic data streams. Its self-guided filtering layer is designed to remove noise, enhance clarity, and preserve details, ensuring the best quantitative and perceptual performance under complex weather conditions.

## Key Metrics

**1. Describe Your Innovation: Design/Technology - How Does It Work?**

The Self-Guided Filter TransWeather (SFTW) model is innovated on the TransWeather model introduced in 2022, designed to restore images degraded by adverse weather conditions. SFTW uses a single encoder-decoder architecture, which processes multiple weather types within a single-unified framework(model). Key Components include:

**Transformer Encoder**:

* **Patch Processing**: Input images are divided into smaller patches to extract precise features.
* **Attention Mechanism**: The encoder uses multi-head-self-attention to model relationships across different regions of the image, based on global and local features.
* **Feature Restoration**: Outputs are refined using feed-forward-networks to ensure the learned features are relevant for the restoration task.

**Transformer Decoder**:

* **Weather-Specific-Queries**: The decoder used learnable weather embeddings (Queries,Keys,Values)(Q,K,V) to identify and restore specific weather degradation-types (e.g., rain, fog).
* **Feature Reconstruction**: Combines the encoded-features with weather-specific-queries to restore the clear images. Hierarchical features extracted by the encoder are integrated during this.
* **Final Projection**: Restored features are upsampled through convolutional layers, outputting the final cleaned image.

SFTW further enhances the base model with three core innovations:

1. **Self-Guided Filtering Layer:**  
   Filters improves noise removal, edge preservation, and restoration quality of images.Traditional filters works on external references(guide) or pre-defined parameters, making it highly unpractical, but SFTW’s self-guided filter dynamically adjusts and learns its weights during training, within the framework itself with a same filter-effect.
2. **ResNet50 Backbone:**  
   SFTW uses ResNet50’s deeper architecture and residual connections, for more efficient feature extraction. ResNet50 captures both low-level-details(e.g., textures) and high-level abstractions(e.g., light-streaks) better than VGG16, improving overall performance and ability.
3. **Real-Time Video Processing Capability:**  
   Existing models can only process static images, while SFTW is able to process dynamic frame-streams. This unique feature addresses the requirements of real-world applications requiring immediate visual feedback, and is the first existing model to do this.

Adverse weather conditions degrade image quality, leading to blurring, reduced-contrast, noise, and blockage of features. Traditional models has limitations, including training on synthetic datasets, weather-specific designs requiring multiple models, and high computational complexity.

SFTW resolves these pain points by:

* **All-in-One Functionality:** SFTW’s base-Transweather uses a single-encoder-decoder design, able to process multiple weather types together, in mixed conditions, where existing methods requires multiple specific-models to be trained.
* **Efficiency:** SFTW has the simplest architecture, which allows it to take up minimal running memory, making it suitable to integrate into less-powerful hardware products everywhere.
* **Practical Usability:** Real-time-video-processing ensures reliable visual feedback in dynamic weather, for time-sensitive applications like autonomous driving.

**What Impact Does Your Innovation Create for Individual Users and Humankind?**

SFTW is a significant step forward in making weather-degraded image restoration practical and accessible, bridging the gap between the current stage of academic research and real-word-practicality, aiming to actually benefit human informatics revolution. Its impact extends to individual users, industries, and society:

**For Individuals:**  
Hobbyists and professionals relying on drones/AR/VR devices benefit from SFTW’s ability to restore image clarity, ensuring a more immersive experience regardless of weather conditions, eg.By removing raindrops stuck-on-camera.

**For Industries:**  
Autonomous vehicles, surveillance systems, and environmental monitoring applications rely heavily on clear visual inputs. SFTW ensures that adverse weather does not block or degrade such inputs, ensuring safety and reliability.

**For Humankind:**  
In the future, CV applications are going to be applied everywhere in our lives, and our safety are dependent on their stability. SFTW addresses challenges posed by AI systems in life-critical missions such as search and rescue. SFTW ensures a cleared image input, enables AI systems to make accurate decisions, preventing tragedies and saving lives. It eliminates the major natural-inevitable challenge, ensuring that technology serves humanity’s highest purpose: saving lives and building a safer future for the people.

**How Can New or Proprietary Aspects Be Protected and Made Valuable?**

SFTW model itself builds upon the TransWeather base, which is open-sourced, and its proprietary implementation and integration of features can be protected through trade secrets or copyright. We can also add continuous updates to the model to ensure it remains competitive and ahead of market trends, maximizing its long term value, especially to the stage of widespread CV applications.

### Validation/ Progress

**Validation: How Have You Validated the Innovation?**

1. **Patent Submission**: To protect the proprietary aspects of SFTW, we planned to submit a patent application on the integration of the self-guided filter layer and its implementation within weather-degraded image restoration systems, as our major innovation. This ensures that the innovation can be commercialized and maintaining its competitiveness, as a self-guided filter is specifically designed to restore image quality and remove noise.
2. **Academic Publication**: The CEO/CTO is preparing to submit the research paper(pure-tech) to leading journals and conferences in computer vision and AI technologies. Including **IEEE Transactions on Image Processing** and **CVPR Proceedings**. This way we can aim to contribute to the academic community and further validate the technological advancements of the SFTW model, exchanging views.

**Progress: What Progress Has Been Made in Developing the Innovation?**

1. **Conceptualization**: The innovation began with the idea of addressing the limitations of existing weather restoration models, especially their inability to process mixed real-world conditions and dynamic frame streams. The self-guided filter was identified as the core component to balance noise reduction and detail preservation.
2. **Prototype Development**: The initial integration of the self-guided filter layer into the TransWeather base is the first step in the innovation. Early prototypes are mainly aiming to enhance the single encoder-decoder structure and replacing the VGG16 backbone with ResNet50 for deeper feature extraction and better generalization. Another TransWeather model was trained, purely for comparison and optimizing training hyperparameters.
3. **Testing and Iteration**: Controlled testing using the same ‘Allweather’ Dataset was performed to evaluate the model’s performance. Metrics like PSNR and SSIM were measured to assess the quality of restored images in terms of noise removal and structural similarity.
4. **Real-Time Capability**: A key breakthrough developing the real-time video processing. The concept is simple, breaking apart a video-feed’s inputs into frames, individually processing each just like static images, and combining them back to a video.
5. **Application-Specific Testing**: SFTW has not yet been tested under real life conditions, as in effectiveness of applications in autonomous-vehicles and such, however, SFTW is guaranteed to process real-world images as it is trained on Real world datasets (Raindrop)

### Market

**Customer and Target Segments**

**B2B**  
Industries+Businesses on autonomous driving, drones, and surveillance-systems depend heavily on reliable outputs for users. Autonomous driving companies like Baidu Apollo and XPeng requires advanced Computer-vision models to operate safely in adverse weather conditions. China’s expanding AI surveillance sector, for smart city projects, requires clear, functional imaging in any environment.  
Efficiency and reliability are important to them.

**B2C**  
Individual-users using drones, AR/VR devices, and smartphones for photography face challenges when weather degrades image quality. SFTW provides these users with high-quality solutions that restore image clarity allows them to restore their images. They want simple, fast, and effective solutions that enhance their user experience.

**B2G**  
Governmental-organizations(Firefighters,etc.) may use CV for rescuing and disaster-management agencies require tools for real-time image and video restoration during emergencies, when it is threatening for humans. SFTW’s real-time processing capabilities ensure that operations like search-and-rescue and disaster relief can function effectively, when powered with other hardware.

**Buyer vs. Payer**  
In B2B and B2G markets, procurement teams or agencies (buyers) differ from payers (budget holders or stakeholders). For B2C, the buyer and payer are often the same individual, with a simple model.

**Industry Ecosystem**  
China’s **New Generation AI Development Plan** and **Smart City Initiatives** promotes the integration of AI technologies into real-life, with SFTW added to them ensuring safety, encouraged by **Emergency Response Law of the People’s Republic of China**.

The autonomous driving market in China is projected to exceed ¥700 billion by 2030, while the AI surveillance market is valued at ¥1 trillion. The consumer drone market in China is also estimated to reach ¥60 billion by 2025, where each user could use SFTW for a small cost.

These policies, with rising investments in public safety and autonomous technologies, create an encouraging ecosystem where SFTW aligns perfectly with the nation’s priorities in innovation+technology.

### Competition

Our innovation faces competition from established players in China, for example Xiaomi and Hikvision, companies with emerging startups focusing on AI-driven imaging solutions. Xiaomi is a leading company in consumer electronics with smartphones and smart hardware. Hikvision, a security camera company, embeds advanced AI algorithms to clear up security recordings. While such competitors dominate the current market, our innovation provides many more advantages, indicating promising opportunities.

Our innovation excels in image clarity, practicality and efficiency, especially in adverse weather and high-dynamic-range (HDR) scenarios. Our technology ensures 100% clarity, which outperforms competitors like Xiaomi, offering blurry images in most scenarios, and Hikvision, which provides only about 70% clarity in similar conditions. Another major advantage is that our technology has combined models for different weather conditions, differently to current competitors. This greatly increases the technology’s practicality and efficiency in different fields and industries, such as security, autonomous driving, and much more.

However, our advantage comes with challenges, such as the need for vigorous marketing. Due to the current market situation, our competitors are all clearly established, making it more complicated for our new technology to join this competition for customers. This means more effort, connections, and marketing will need to be made to educate potential customers about our benefits and superiority in this field.

Our technology is as the premium choice for businesses seeking unmatched clarity in various challenging weather circumstances. Our unique selling point on leading image clarity and practicality greatly differentiates us from the market, allowing the operation of AI models to optimize performance across multiple industries.

### Go To Market

The model will use different strategies to enter the **B2B**, **B2G**, and **B2C** markets. At first, we will set up our own **online platform/app** where users can directly access and try the SFTW model. This allows personal photography-enthusiasts, small-businesses, and individual users to test the model’s capabilities under various weather conditions and provide valuable feedback first. This ensures the model will function safely before being utilized in high-stakes scenarios like rescues.

Focusing on individual users and businesses first will be a safer and more-controlled testing environment. **Government-rescue-organizations**, such as IRC, require high levels of reliability, and introducing the model to these sectors without thorough testing leads to issues in life-threatening situations. After refining the model based on user feedback from the online platform, we will expand to **businesses such as security camera manufacturers** and eventually target government sectors through direct sales or strategic partnerships.

### Business Model

As a personal-software-company, our **primary costs** include **server rentals and utility fees**. Our server rental costs are approximately **￥1.58 CNY/hour**, which totals **￥1137.6 CNY/month**, which is highly affordable. Since our team works remotely, office and lab-space fees+rents are negligible. **Utility-fees** including purchasing and preprocessing datasets for training and experimentation, varies and are a small portion of our expenses. In total, our ACTUAL **monthly operational costs are capped at approximately ¥1500**, excluding marketing fees during the model's development and experimental phase. We have a relatively-low cost, ensuring efficient pricing and operations, as a baseline for determining our product pricing.

To align with the ethical practices from fellow CV-developers, **we will open-source the basic version of our SFTW model**, which focuses on static image restoration only. This decision comes from the fact that current existing static image restoration models in the market, like our base model TransWeather, are indeed available online for free. Profiting from this basic functionality would be both unethical and limit accessibility to personal users and developers.

Our **advanced versions**, including real-time video (LV+SFTW), will be offered through a **tiered pricing model**. For **B2B customers**, such as security camera manufacturers, the price per unit is set at roughly **¥19,999**, which is an affordable and highly effective alternative to other models priced between ¥50,000 and ¥200,000. For **B2G collaborations** (e.g., rescue organizations), the price could be further adjusted through **government subsidies**, or offered free to governmental organizations.

This pricing strategy is very affordable for businesses while maintaining profitability, as our product has superior performance in weather-degraded image restoration compared to all existing-methods. The basic version is free and we offer affordable pricing for advanced versions, we aim to make this technology widely accessible, to benefit a broader audience, and create value across all sectors related to CV’s future.

1. **Fundraising**

**Expected Revenue Growth:**

* **2025:** Revenue projected to grow by 50%, driven by B2B and B2C sales.
* **2026:** Expected 80% revenue growth, supported by governmental rescue partnerships.
* **2027:** Revenue forecasted to double, with major contributions from B2G collaborations and enterprise clients like Hikvision .

**Sources of Funding:**

* **Venture Capital:** Targeting hard-tech-focused firms like Jiadao Capital (嘉道), Yaotu Capital (耀途), Sequoia Capital (红杉), and Shanghai Kechuang (上海科创), utilizing their expertise in AI and intelligent systems.
* **Government Grants:** Policies like “十四五”规划 and AI subsidies support R&D and commercialization. Partnerships with Red Cross organizations can cooperate rescue applications.
* **Crowdfunding:** Platforms like Modian (摩点) enable public engagement and product feedback, as well as from our own platform.

Funds will support R&D, server-rentals, marketing-campaigns, and recruitment, ensuring scaling and commercialization of SFTW.