

A novel transient IR imaging (TIRI) to detect and quantify building air leakage

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Research Challenges in Building Air Leakage Detection and Quantification

- Current technologies cannot nonintrusively detect leaks with small temperature differences and low air-flow rates
 - Blower door tests (intrusive): time consuming, cumbersome, disturbing to occupants¹
 - Traditional IR imaging (**nonintrusive**): low accuracy and sensitivity—difficult to detect small leaks, small temperature difference, or nonuniform surface emissivity^{1,2}

Current Research

Proposed and demonstrated a novel TIRI method to detect

Theoretical basis



.ab tests

leaks by analyzing transient IR images when HVAC turns on/off¹

- Successfully demonstrated detection and quantification in lab
- Successfully demonstrated detection in field tests¹
- Advantages beyond the state-of-the-art
 - **Nonintrusive:** Needs only an IR camera
 - **Simple:** No need for (de)pressurization fans or assemblies
 - Fast and accurate: Detect air leakage locations within 10 s when temperature difference is >2°C
 - **Comprehensive:** Works in **all four seasons** ____
 - Reliable: Can easily separates leakages from thermal bridges

Planned/Future Research

Train machine learning model to detect and quantify leakage



- Evaluate effect of outdoor environmental factors (e.g., wind speed, temperature, humidity)
- Integrate TIRI technology into IR cameras
 - Industry partner: Fluke

1. Feng, Shen, Shrestha, Hun, J. Build. Eng., 91, 109699 (2024). 2. Patent: Feng, Shen, Shrestha, 63 542 999 (2023).



Field tests on a residential building



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