

Thermal Risks and Smart Intervention Strategy

Maintaining thermal comfort within the vehicle cabin is crucial for both driver alertness and well-being. Exposure to uncomfortable temperatures — whether excessive heat or cold — can increase fatigue, reduce concentration, and ultimately impact driving safety.

To address these risks, an intelligent seat management system must proactively adapt the thermal environment using real-time cabin temperature data. Rather than relying on manual input, the system continuously monitors ambient conditions and autonomously adjusts seat heating and ventilation levels to ensure an optimal experience.

Adaptive Ventilation for High Temperatures

When the cabin temperature exceeds 20°C, the system activates the seat ventilation feature in a graduated manner:

- At mild warmth (21–23), ventilation remains off, preserving a neutral comfort baseline.
- As heat intensifies (24–28), low-level airflow is introduced to prevent thermal buildup.
- In moderate heat (29–32), ventilation is increased to level 2, enhancing evaporative cooling.
- At 33–36, level 3 provides strong airflow to counteract discomfort.
- For conditions reaching 37–40, level 4 ensures aggressive cooling action.
- Beyond 41, the system maximizes ventilation to level 5 for urgent thermal relief.

This dynamic adjustment helps avoid perspiration, skin irritation, and thermal stress during summer driving — particularly in vehicles parked under direct sunlight.

Proactive Heating in Cold Environments

Conversely, when cabin temperature drops below 20°C, the system shifts its strategy toward heating:

- At mildly cool conditions (17–19), heating is applied at level 1, offering gentle warmth.
- For colder environments (14–16), level 2 provides consistent comfort — a setting shown to significantly improve perceived well-being.

- When temperatures fall further (11–13), level 3 supports body thermal regulation by delivering deeper heat penetration.
- In chillier cabins (8–10), level 4 reduces muscular tension and prevents shivering.
- If the temperature plunges below 8, heating is ramped up to level 5, ensuring rapid thermal stabilization.

This adaptive heating strategy minimizes thermal discomfort, especially during early-morning drives or in winter climates, promoting both comfort and alertness.

Conclusion: Toward a Smarter Thermal Experience

By integrating smart rules into the thermal management system, the vehicle can autonomously sustain an ideal seating climate tailored to the driver's real-time environment. Such intelligent adaptation is essential not only for enhancing in-cabin comfort, but also for supporting driver safety and physiological balance across varying weather conditions.