Behind the Scenes: How Acoustic Imaging Technology is Helping the Finnish National Opera and Ballet Run Smoothly

With thousands of moving parts powering the stage machinery, the Finnish National Opera and Ballet relies on precision maintenance to ensure flawless performances. The FLIR Si2 Acoustic Imaging Camera helps the maintenance team detect mechanical faults early on, even in the most hard-to-reach areas. By pinpointing issues with bearings, pulleys, and other critical components, the Si2 enables efficient, non-contact inspections, preventing costly breakdowns and ensuring uninterrupted stage operations.

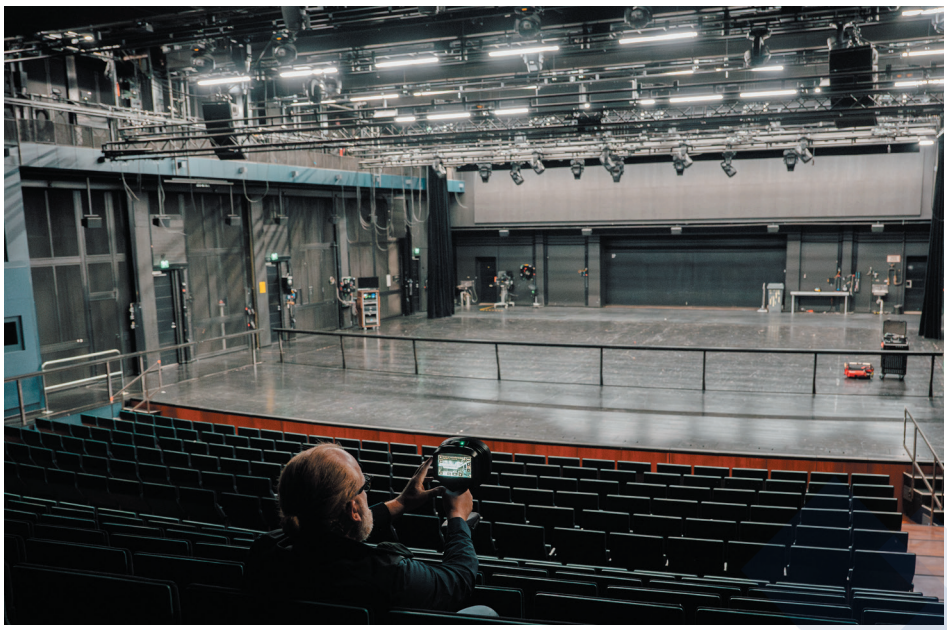
Staging close to 500 performances a year, the Finnish National Opera and Ballet (FNOB) plays a significant role in Finland's cultural landscape, attracting around 250,000 spectators annually.

Built in Helsinki in 1993, the vast, 40,000 sqm facility is equipped with advanced stage machinery to facilitate complex scene transitions, meet the demands of contemporary productions, and uphold high safety and performance standards. The main stage alone is operated using 200 motors—this means thousands of bearings, rollers, pulleys, and other mechanical components must work seamlessly together to ensure flawless set changes, precise movements, and a perfect performance for the audience, night after night. For the maintenance team, it means relentless precision behind the scenes.

Towering Heights, Tight Spaces, and Massive Moving Parts: The Unique Challenges of Maintaining a World-Class Opera House

The one-of-a-kind architecture of the Finnish National Opera and Ballet—including specialized stage machinery, tight, shallow spaces several meters beneath the stage, massive moving floor elements weighing up to 10,000 kilos, and high-altitude settings—creates a uniquely challenging environment for the maintenance crew. Every component, from towering set pieces to intricate pulley systems, must function flawlessly to ensure seamless performances, but inspecting and maintaining their condition is no easy task. When maintenance and repairs can only be scheduled for the short off-season window during summer months, consistent and reliable monitoring becomes essential.

Mech Mode for mechanical fault detection is included in the FLIR Si2-LD and Si2-Pro models.



Almi Hall, Finnish National Opera and Ballet, Helsinki.

Early Detection of Mechanical Faults Keeps the Stage Running Flawlessly

The FLIR Si2 Acoustic Imaging Camera featuring Mechanical Mode functionality is a game-changer for maintenance at the Finnish National Opera and Ballet, allowing the team to detect mechanical issues like bearing faults quickly and from a distance—before they escalate into costly failures. The Mech Mode pinpoints and analyzes subtle anomalies in sound patterns that indicate friction, wear, or misalignment in bearings and other moving parts. This enables the crew to identify issues without direct contact, even in hard-to-reach areas such as tight spaces beneath the stage or high-altitude rigging systems. By catching faults early, Mech Mode helps prevent unexpected breakdowns, minimizes downtime, and ensures that the intricate stage machinery operates flawlessly for every performance.

The FNOB maintenance crew says that the Si2 acoustic camera not only speeds up their work by swiftly pinpointing the precise location of the issue from a distance, but also removes guesswork from repairs—a trait much appreciated when dismantling a part of a unique structure requires a special hoist to be ordered on-site. It also allows for consistent monitoring and maintenance of an identified issue in an effort to optimize the lifespan of expensive parts, like in the case of a bearing emitting abnormal noise in a hard-to-reach light bridge that costs tens of thousands to replace.

The Si2 minimizes reaction time for short-term emergency repairs when an operator reports an issue during a show. In one instance, the camera identified a defective bearing in a stage curtain at a height of over 15 meters, allowing the maintenance team to address the problem immediately and prevent further disruption. Additionally, using the Si2 helps reduce maintenance costs by guiding external service teams directly to the defective component, eliminating the need for a costly full inspection.

Typical Maintenance Challenges at Premier Performing Arts Venues like the Finnish National Opera and Ballet:

- **Confined and Hard-to-Reach Spaces:** Tight spaces and hard-to-reach areas make inspections and repairs difficult.
- **Massive Moving Elements:** Heavy stage components require specialized equipment for maintenance.
- **High-Altitude Work:** Overhead rigging, lighting, and set pieces demand operations at significant heights.
- **Complex Stage Machinery:** Thousands of moving parts, including motors, pulleys, and bearings, must function flawlessly.
- **Limited Maintenance Windows:** Repairs often need to be scheduled during short off-season periods.
- **Precision and Reliability:** Any mechanical failure could disrupt performances and impact artistic integrity.
- **Safety Risks:** Maintenance work involves unique structures and heavy elements in confined spaces, and high-altitude settings.
- **Continuous Monitoring Needs:** Proactive tracking of wear and potential failures is essential to prevent breakdowns.

Key Benefits of Using the FLIR Si2 for Mechanical Fault Detection at Premier Performing Arts Venues

- Early Fault Detection and analysis: Identifies and analyzes bearing wear, friction, and misalignment before they lead to costly failures.
- Non-Contact Inspection: Allows the crew to assess components from a safe distance.
- Access to Hard-to-Reach Areas: Detects mechanical issues in tight spaces beneath the stage and high-altitude rigging systems without dismantling equipment.
- Minimized Downtime: Enables predictive maintenance, reducing the risk of sudden breakdowns that could disrupt performances.
- Enhanced Safety: Limits the need for maintenance staff to work in high-risk areas, such as overhead stage structures and confined machinery zones.
- Efficient Off-Season Repairs: Provides reliable data for targeted maintenance during a limited off-season repair window.
- Optimized Performance: Ensures that the thousands of moving components function seamlessly, keeping set changes, lifts, and stage movements flawless night after night.
- Faster Emergency Response: Minimizes reaction time for short-term emergency repairs, ensuring quick intervention when an operator reports an issue during a show.
- Precision Fault Detection: Accurately identifies defects, such as a faulty bearing in a high-altitude stage element, enabling targeted maintenance and preventing performance disruptions.
- Reduced Maintenance Costs: Helps lower expenses by guiding external service teams directly to the faulty component, eliminating the need for costly full inspections.

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