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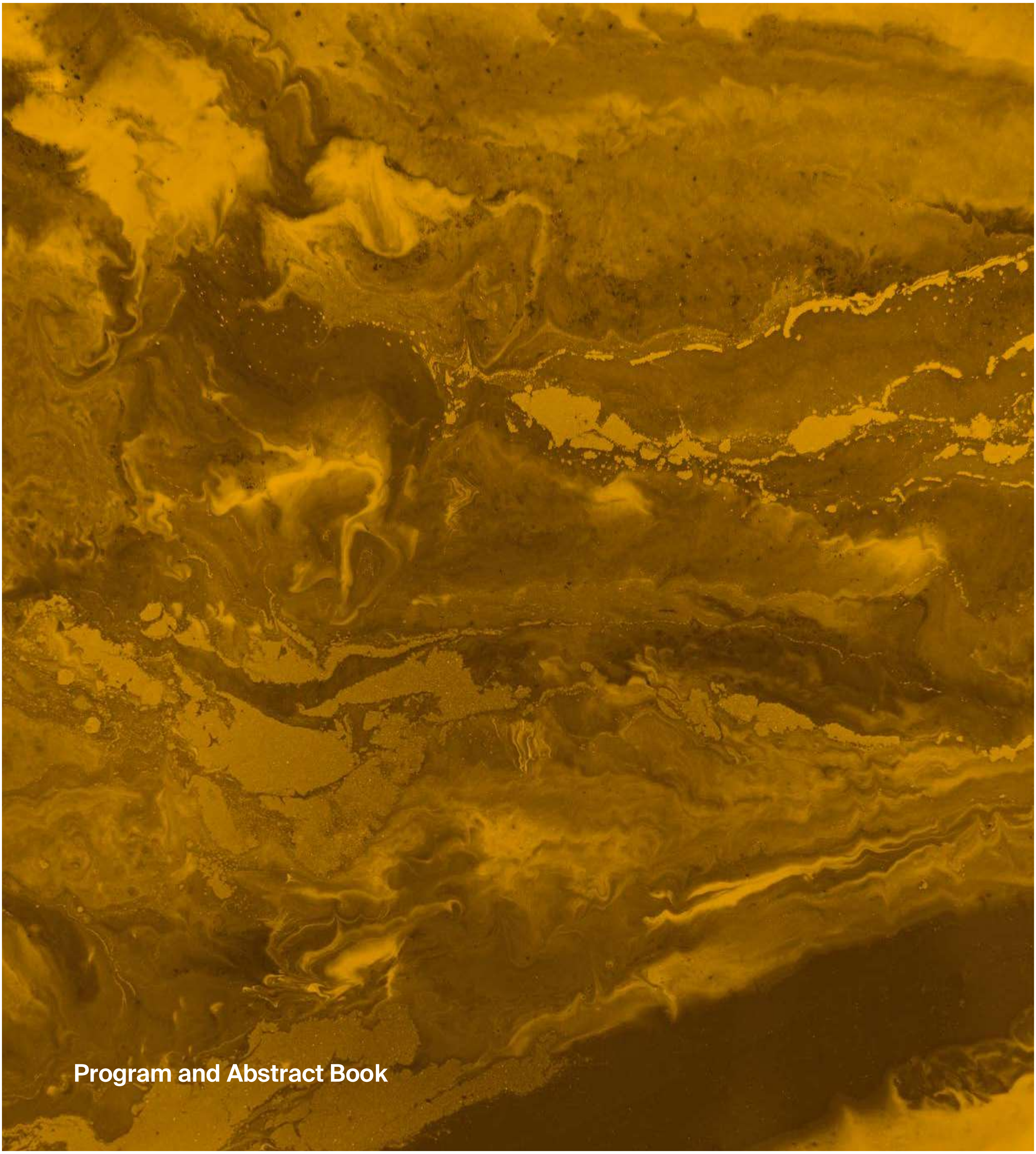

Program and Abstract Book

sciforum-114942: High-Temperature Fatigue Testing of Turbine Blades

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This study introduces an innovative experimental setup for high-temperature fatigue testing of full-scale nickel-based turbine blades protected with aluminide coating, aiming to replicate operational conditions and enhance service life predictions. A patented grip system was developed to enable precise determination of the S–N curve and hysteresis loop evolution under simulated extreme conditions. The blades were tested at 950°C with cyclic bending loads ranging from 5.2 kN to 6.6 kN at a frequency of 10 Hz. A preliminary bending test established the force–displacement relationship, providing critical input for fatigue testing parameters. The setup integrates an Inconel alloy testing stand with an induction heating system, ensuring uniform temperature distribution with deviations limited to ±3°C. Advanced monitoring techniques allowed for high-frequency data acquisition, facilitating the capture of force-displacement relations and hysteresis loop development. Results revealed distinct behavioral transitions, including elastic responses and plastic deformations at higher force amplitudes, contributing to a comprehensive understanding of fatigue-induced damage mechanisms. Key findings underscore the effectiveness of this methodology in capturing the complex mechanical responses of turbine blades under high-temperature cyclic loading. The proposed setup addresses the limitations of conventional standardized specimen testing by enabling full-scale component evaluation, thus offering significant advancements in material performance assessment for aerospace applications. This work represents a critical step toward optimizing the design and durability of high-temperature components, aligning with the demanding requirements of modern turbine technologies.