Siberian Federal University
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An Automatic Test Complex for Unmanned Aerial Vehicle Engines

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Tasks of aircraft ground testing:

**Ground Autonomous Tests (GAT):**
Qualitative performance check and reliability assessment of the main units and systems: engines, control systems, supporting structures, etc.

**Ground Complex Tests (GCT):**
Comprehensive verification the combined action of individual units and systems in conditions close to flying.

**Ground tests for external factors:**
- climatic factors;
- vibration effects;
- shock effects;
- linear accelerations;
- acoustic noise;
- combined tests, etc.
Resource-saving technology for debugging UAV systems:

- predominance of mathematical and semi-natural modeling in comparison with field investigation;
- ensuring the reliability and adequacy of ground-based tests of the UAV components to their regular functioning;
- conducting unit testing of on-board software.

Measurements and tests:

- torque, speed and power on the propeller shafts of UAV propulsion devices;
- forces acting along the longitudinal, transverse and vertical axis of the moving platform;
- electric power consumed by the UAV engine;
- UAV vibration and acoustic characteristics;
- video recording of UAV operation process;
- documentation and visualization of measurement results.
The UAV Engine Test Complex:

- PXIe-1435
- PXIe-4464
- PXIe-6537
- PXIe-4339
- PXIe-4302
- PXIe-1082
- PXIe-8821
- CB-2162
- CB-2162
- TB-4339
- TB-4302
- TB-4302
- PXIe-4464
- PXIe-1435
- PXIe-1082
- Chassis

- High Speed Cameras
- Measurement Microphones
- UAV Engine Functional Control
- Speed Sensors
- Torque Sensors
- UAV Engine
- Force-Sensitive Resistive Sensors
- Piezoelectric Vibration Sensors
- 6-DOF Platform Manipulator Construction
- Connector and Terminal Blocks
## Technical characteristics and results of tensometric measurement assessment:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Digital input/output channels</td>
<td>32</td>
</tr>
<tr>
<td>2. Analog input channels</td>
<td>32</td>
</tr>
<tr>
<td>3. Analog input channels with galvanic isolation</td>
<td>8</td>
</tr>
<tr>
<td>4. Analog input channels for bridge-based sensors</td>
<td>8</td>
</tr>
<tr>
<td>5. Input frequency range</td>
<td>5 Hz–5 kHz</td>
</tr>
<tr>
<td>6. Measuring range of forces acting on the moving platform</td>
<td>5–1000 N</td>
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<tr>
<td>7. Measuring range of moments acting on the longitudinal, transverse and vertical axis of the moving platform</td>
<td>1–100 N·m</td>
</tr>
<tr>
<td>8. PVS dynamic acceleration range</td>
<td>up to 500 m/s²</td>
</tr>
<tr>
<td>9. PVS operating frequency range</td>
<td>2 Hz–10 kHz</td>
</tr>
<tr>
<td>10. Nominal TS torque</td>
<td>50 N·m</td>
</tr>
<tr>
<td>11. Maximum speed of the TS shaft</td>
<td>8000 rpm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter name, measurement conditions, unit</th>
<th>Parameter value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weight applied to the force-sensitive sensors s₁, s₂ mounted on the movable support pair (I), the value of calibration weight is 10 g, N</td>
<td>s₁: 0.0982, s₂: 0.0941</td>
</tr>
<tr>
<td>2. Calculation results of the force vector components, the mass distribution at the support attachment points: I – 10 g, II – 20 g, III – 50 g</td>
<td>x-axis: 0.0036, y-axis: 0.0037, z-axis: -0.0320</td>
</tr>
<tr>
<td>3. Calculation results of the force moment vector components, the mass distribution at the support attachment points: I – 10 g, II – 20 g, III – 50 g, N·m</td>
<td>x-axis: 0.0034, y-axis: -0.0032, z-axis: 0.0000</td>
</tr>
<tr>
<td>4. Mass applied to the center of gravity of the moving platform, the value of calibration weight is 10 g, N</td>
<td>0.1460</td>
</tr>
<tr>
<td>5. Duration of the transition process for the force-sensitive sensors, the value of calibration weight placed at the support attachment points I–III is 20 g, s</td>
<td>s₁: 1.78, s₂: 1.87, s₃: 1.80, s₄: 1.85, s₅: 1.82, s₆: 1.80</td>
</tr>
</tbody>
</table>