Large Aircraft Depaint Manipulator Initiative
Materials and Manufacturing Directorate of the Air Force Research Laboratory

Aircraft Maintenance Platform
A Lightweight, Suspended, Multi-Axis Work Platform

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Current De-Paint Process Problems

PROJECT NEED

- Existing equipment
  - Difficult to maneuver accurately
  - Uncoordinated motions
  - Frequent collisions

- Setup time
  - Delays productive portions of de-paint process

- Ground clutter
  - Hinders efficient access of aircraft

- Ergonomic issues
  - Causes operator fatigue/injury
  - Lost labor hours (avg. one per shift)
  - Damage to aircraft skins from trigger work-around and nozzle dwell time
AMP Project Goals

PROJECT NEED

DEPAINT PROCESS IMPROVEMENTS:

- Reduce flow time by:
  - Eliminating ground based scaffolding, hoses and other inefficient clutter
  - Improving positioning accuracy and efficiency in all phases of process
  - Increasing blasting time by reducing fatigue/injury, maximizing labor

- Reduce direct costs:
  - Requiring no heavy duty hangar structure, deploys from existing facilities
  - Reduce collisions caused by operator positioning errors
  - Manipulator integration for blasting will minimize fatigue/injury
Targeted Aircraft

CARGO

C-130 HERCULES
LOCKHEED

C-141 STAR LIFTER
LOCKHEED

C-5 GALAXY
LOCKHEED

TANKERS

KC-10 EXTENDER
BOEING

KC-135 STRATOTANKER
BOEING

KC-10

11-Mar-05
AMP Dry Media Blasting
OPERATIONAL AMP DEPLOYMENT

EACH COLORED SECTION REPRESENTS MORE THAN A SHIFT OF BLASTING

SECTION: 10 PATCHES = 360 ft²
1 SWATH = 100 ft²

CURRENTLY: 460 ft² @ 1 ft²/min = 460 minutes = 8 hours of continuous blasting

OUR GOAL: Three nozzles, faster access, better ergonomics, more trigger time...
TWO SECTIONS = ONE OPERATOR FOR ONE SHIFT
Technology Transfer
TEAMING ARRANGEMENT

SPONSOR
AIR FORCE RESEARCH LAB

PRIME CONTRACTORS
US TECHNOLOGY CORP
JAMES GREGORY ASSOCIATES

TECHNOLOGY COLLABORATORS
INTELLIGENT SYSTEMS DIVISION
AEROSYSTEMS CORP
US TECHNOLOGY CORP

CUSTOMERS
Hill Air Force Base, Utah
Ogden Air Logistics Center
Robins AFB
Lockheed Martin
Boeing
TEAM ASSET:
- 20 years of de-paint experience supporting over 600 aircraft
- Application sales and support for dry media stripping at ALCs and private sector

SUPPORT PROVIDED:
- Component specifications.
- Blast system
- Ganged nozzles
- Plastic media
TEAM ASSET:
• 12 years experience developing and manufacturing overhead access platforms for aerospace industry

SUPPORT PROVIDED:
• Component specifications
• Component purchases
• Platform fabrication
• Trolley system
TEAM ASSET:
• 25 years experience developing automation for industry
• RoboCrane technology
• Demonstrations for large scale manufacturing applications

SUPPORT PROVIDED:
• System design
• Component specifications
• Controllers for AMP and Tripod
• Performance testing
AMP Payload Targets
OPERATIONAL AMP DEPLOYMENT

Personnel Deployment:
- Two person “live load” (600 lbs)
- Hand tools and inspection devices
- Blast cab or basket
- Tripod manipulator
- Blast hoses
- Dry media blast pots

Cargo Handling:
- Precision (6 dof) cargo placement
- No personnel means double the safe working load
Warner Robins AFB, Bldg 50
OPERATIONAL AMP DEPLOYMENT
Maximum Cable Tension Calculations

**AMP DESIGN CRITERIA**

Lower Triangle: \( X=0 \quad Y=9' \quad Yaw=0 \quad Z=7' \)

Lower Triangle: \( X=9' \quad Y=0 \quad Yaw=0 \quad Z=7' \)

Maximum Tension: 1,959 lbs

Maximum Tension: 1,974 lbs
AMP Workvolume
OPERATIONAL AMP DEPLOYMENT

Tinker AFB
Bldg. 2122
KC-135

Drive Module
Purged enclosure
(below w/motors&amps)
Winches
(mounted to T-frame)
T-frame
(box or I-beam)

AMP - Overall Configuration
for Tinker ALC, Bldg. 2122
50' Upper Triangle shown
Scale 1.0" = 15'
Bob Bunch 10-10-01

11-Mar-05 [24]
Platform Joystick

HUMAN-MACHINE INTERFACE COMPONENTS

P-Q Controls Inc.
[Model 220]

- 4-DOF (X, Y, Z, Yaw) w/digital trigger
- Industrial quality
- Inductively coupled mechanisms
- Intuitive Platform Velocity Inputs:
  - X: lean left - lean right
  - Y: push forward - pull back
  - Z: grip twist (open/up - close/down)
  - Yaw: (about Z) rotate via thumb
- Trigger provides motion enable
  - Trigger engage generates a 'controller run' to 'begin 'servo', release brakes and enable amplifiers, acceleration limited motion.
  - Trigger release generates a 'controller stop' to decelerate, then brake & disable amp.
PC/104 Industrial Computer

CONTROLLER COMPONENTS

Real Time Devices IDAN PC/104

FEATURES:
- Established PC-104 form factor
- Established PC-104 vendor
- Compact design
- Rugged construction
- Shock mounted
- Solid state disk
- Battery backed RAM
- Closed, heat-sink enclosure
- High temperature band
- Modular configuration
- Interchangeable cards
- Wide variety of capabilities
AMP Payload
OPERATIONAL AMP DEPLOYMENT

ENCLOSED BLAST CAB WITH TRIPOD MANIPULATOR