Bio-Inspired Actuators
GRIFFIN meeting

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Bio-Inspired actuators

Inspiration in animals: **Mimicking** behaviour using alternative actuation methods
- Latest Publications
  - Bio-inspired morphing tail.
  - Analysis of perching forces.

- Working On
  - Morphing aerodynamic flexible wing.
  - Perching system comparison.
  - Himself actuated perching mechanism.
  - Bio-Inspired claws.
Bio-Inspired Morphing Tail

- Inspired on birds V-tails
- MFC structure and actuation
- Actuation from 150V to 1500V
- Bimorph configuration
- Natural displacement

TAIL CONFIGURATIONS

- Asymmetric YAW
- Symmetric PITCH
- Air-Brake

STRAIGHT FLIGHT TEST COMPOSITIONS

TURN FLIGHT TEST COMPOSITIONS

Perching Maneuver Forces Study

• Based on the one degree of freedom vibration equation.

\[ \dot{u}(t) = e^{-\zeta \omega_n t} (A \cos \omega_D t + B \sin \omega_D t) \]

Balance Equation

\[ m_a \ddot{u}(t) + C \dot{u}(t) + 2Ku(t) = -mg \cdot \cos \alpha \]

• Development of a perching mechanism supplying the forces calculation.
  • Based on magnetic field forces.
  • Ultra light weight system.
  • Absorbing the perching impact forces


V. Perez-Sanchez, A. E. Gomez-Tamm, F.J. Garcia-Rubiales, B.C. Arrue and A. Ollero
Morphing Flexible WING

- Aerodynamic Profile
- Soft bio-inspired tip
- Morphing Wing
- Reinforced leading edge
- Improving control capabilities
Claws and Perching Mechanism

Bio-Inspired Claws

V1

V2

V3

Magnetic Perching Mechanism

Spring Perching Mechanism
Claws and Perching Mechanism

Bio-Inspired Claws

SMA Actuated
Object Delivering
High Grasping Force
Controlled Actuation
Adaptable Grasping

Magnetic Perching Mechanism

Spring Perching Mechanism
Claws and Perching Mechanism

Bio-Inspired Claws

- SMA Actuated
- Object Delivering
- High Grasping Force
- Controlled Actuation
- Adaptable Grasping

V1

Medium Impact Resistance
Reduced Aerodynamic Influence
Impact Absorbance
Better Holding

V2

V3

Magnetic Perching Mechanism

Spring Perching Mechanism
Claws and Perching Mechanism

Bio-Inspired Claws

SMA Actuated Object Delivering High Grasping Force
Controlled Actuation Adaptable Grasping

V1

Medium Impact Resistance Reduced Aerodynamic Influence Impact absorbance Better Holding

V2

High impact Resistance Reduced Aerodynamic Influence Reduced Time of Response High Perching Performance

V3

Magnetic Perching Mechanism

Spring Perching Mechanism
Claws and Perching Mechanism

Bio-Inspired Claws

SMA Actuated Object Delivering High Grasping Force
Controlled Actuation Adaptable Grasping

V1

Medium Impact Resistance
Reduced Aerodynamic Influence
Impact absorbance Better Holding

V2

High impact Resistance
Reduced Aerodynamic Influence
Reduced Time of Response
High Perching Performance

V3

Magnetic Perching Mechanism

High Accuracy
High Perching Force
High Impact Resistance

Spring Perching Mechanism
Claws and Perching Mechanism

**Bio-Inspired Claws**

- SMA Actuated Object Delivering High Grasping Force
- Controlled Actuation Adaptable Grasping

**V1**

**Magnetic Perching Mechanism**

- High Accuracy
- High Perching Force
- High Impact Resistance

**Spring Perching Mechanism**

- Proper for cylindrical Rodes
- High Impact Resistance
- Medium accuracy
- High Grasping force
Spring Perching Mechanism

- Proper for cylindrical rods
- Passive mechanism
- Improving the friction coefficient
- High grasping force

Working with Raphael, Daniel and Saeed
Bio-Inspired Claws

- New geometrical integration
- Improving the impact resistance
- Improving the weight
- Sensing capabilities
- Natural holding improvement
- Improving the friction in the perching
Bio-Inspired Claws

- Inclusion of a Stereo Camera
- Control the SMA heating
- Tracking object in short distances
- Perching place localization

Stereo Camera
Thanks for your attention!