

Dipartimento di Ingegneria industriale

Corso di Laurea in  
INGEGNERIA AEROSPAZIALE

# TITOLO DELLA RELAZIONE

Relazione di tirocinio curriculare in  
Meccanica del Volo

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# Elenco delle figure

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# Elenco delle tabelle

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# Acronimi

|                  |  |
|------------------|--|
| <b>ASI</b>       | Italian Space Agency   |
| <b>DART</b>      | Double Asteroid Redirection Test                               |
| <b>DCO</b>       | Data Cut-Off   |
| <b>DSN</b>       | Deep Space Network   |
| <b>EME2000</b>   | Earth Mean Equator at J2000                                    |
| <b>EMO2000</b>   | Earth Mean Orbit at J2000                                      |
| <b>ESA</b>       | European Space Agency  |
| <b>FOV</b>       | Field of View  |
| <b>FPC</b>       | Flight Path Control  |
| <b>GNC</b>       | Guidance, Navigation and Control                               |
| <b>G/S</b>       | Ground Station   |
| <b>INAF</b>      | Istituto Nazionale di Astrofisica                              |
| <b>I/O</b>       | Input and Output   |
| <b>ISL</b>       | Inter-Satellite Link   |
| <b>JPL</b>       | Jet Propulsion Laboratory                                      |
| <b>LICIACube</b> | Light Italian Cubesat for Imaging of Asteroids                 |
| <b>LIDAR</b>     | LIght Detection And Ranging                                    |
| <b>MA</b>        | Mission Analysis   |
| <b>MCC</b>       | Mission Control Center   |
| <b>MOC</b>       | Mission Operations Center                                      |
| <b>MONTE</b>     | Mission-analysis and Operations Navigation Toolkit Environment |
| <b>NASA</b>      | National Aeronautics and Space Administration                  |
| <b>NAV</b>       | Navigation   |

|              |                                |
|--------------|--------------------------------|
| <b>NEA</b>   | Near Earth Asteroid            |
| <b>NEO</b>   | Near Earth Object              |
| <b>OD</b>    | Orbit Determination            |
| <b>OM</b>    | Orbital Maneuver               |
| <b>OPNAV</b> | Optical Navigation             |
| <b>PHA</b>   | Potentially Hazardous Asteroid |
| <b>PL</b>    | Payload                        |
| <b>PS</b>    | Propulsion System              |
| <b>RCS</b>   | Reaction Control System        |
| <b>RMS</b>   | Root Mean Square               |
| <b>RW</b>    | Reaction Wheel                 |
| <b>S/C</b>   | spacecraft                     |
| <b>SEP</b>   | Sun-Earth-Probe                |
| <b>SOC</b>   | Science Operations Center      |
| <b>SPA</b>   | Sun Phase Angle                |
| <b>SRP</b>   | Solar Radiation Pressure       |
| <b>SSB</b>   | Solar System Barycenter        |
| <b>SSDC</b>  | Space Science Data Center      |
| <b>STM</b>   | State Transition Matrix        |
| <b>TCA</b>   | Time of Closest Approach       |
| <b>UNIBO</b> | University of Bologna          |
| <b>USO</b>   | Ultra Stable Oscillator        |
| <b>WVR</b>   | Water Vapour Radiometer        |



# Introduzione

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$$(a + b)^2 = a^2 + 2ab + b^2 \quad (1)$$

Sed ut perspiciatis unde omnis iste natus error sit voluptatem accusantium doloremque laudantium, totam rem aperiam, eaque ipsa quae ab illo inventore veritatis et quasi architecto beatae vitae dicta sunt explicabo [4–7]. Nemo enim ipsam volupta-

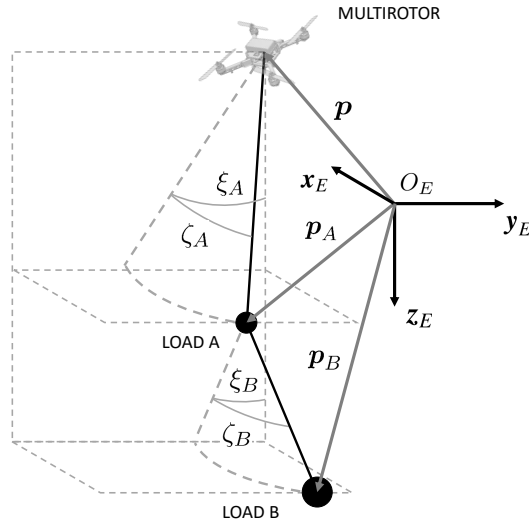


Figura 1: Esempio di figura (nota: i dati numerici vanno caratterizzati con le rispettive unità di misura)

tem quia voluptas sit aspernatur aut odit aut fugit, sed quia consequuntur magni dolores eos qui ratione voluptatem sequi nesciunt (Fig. 1). Neque porro quisquam est, qui dolorem ipsum quia dolor sit amet, consectetur, adipisci velit, sed quia non numquam eius modi tempora incidunt ut labore et dolore magnam aliquam quaerat voluptatem (Tab. 1).

$$\mathbf{F} = m \mathbf{a} \quad (2)$$

Ut enim ad minima veniam, quis nostrum exercitationem ullam corporis suscipit laboriosam, nisi ut aliquid ex ea commodi consequatur [8, 9]? Quis autem vel eum iure reprehenderit qui in ea voluptate velit esse quam nihil molestiae consequatur, vel illum qui dolorem eum fugiat quo voluptas nulla pariatur [10]?

Tabella 1: Esempio di tabella (nota: i dati numerici vanno caratterizzati con le rispettive unità di misura)

| Parametro                       | Simbolo              | Valore | Unità             |
|---------------------------------|----------------------|--------|-------------------|
| Multiroto                       |                      |        |                   |
| Massa                           | $m$                  | 70     | kg                |
| Posizione del centro di gravità | $STA_{CG} = BL_{CG}$ | 0      | m                 |
|                                 | $WL_{CG}$            | -0.15  | m                 |
| Momenti d'inerzia               | $J_{11}$             | 10.61  | kg m <sup>2</sup> |
|                                 | $J_{22}$             | 10.31  | kg m <sup>2</sup> |
|                                 | $J_{33}$             | 19.74  | kg m <sup>2</sup> |
|                                 | $J_{12}$             | 0.037  | kg m <sup>2</sup> |
|                                 | $J_{13}$             | -0.043 | kg m <sup>2</sup> |
|                                 | $J_{23}$             | -0.003 | kg m <sup>2</sup> |
| Elica                           |                      |        |                   |
| Numero di pale                  | $n_b$                | 2      |                   |
| Raggio                          | $R$                  | 0.5    | m                 |
| Corda media aerod.              | $\bar{c}$            | 0.086  | m                 |
| Carico                          |                      |        |                   |
| Massa                           | $m_l$                | 100    | kg                |
| Superficie di riferimento       | $A_l$                | 0.785  | m <sup>2</sup>    |
| Coeff. di resistenza (sfera)    | $C_{dl}$             | 0.5    |                   |

# Conclusioni

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## Appendice A

# Codice Matlab

Esempio di come si riporta un codice.

```
1  clc,clear
2
3  A = 1; % Max. amplitude
4  omega = 5; % Angular frequency (rad/s)
5  phi_o = 10; % Initial phase (rad)
6  delta = 1/sqrt(2); % Damping coefficient (1/s)
7
8  t = linspace(0,10,1000);
9  y = A*exp(-delta*t).*cos(omega*t + phi_o);
10
11 plot(t,y,'LineWidth',1.5)
12 grid on
13 xlabel('time (s)')
14 ylabel('system response')
```

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