



Numerical

INNOVATIVE TECHNOLOGY DESIGNS THE FUTURE

**Riduzione rumore pompa rigenerativa alta pressione
con spaziatura non uniforme**

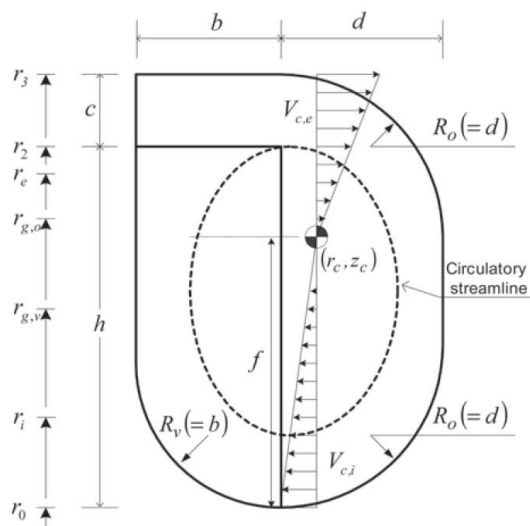


Studio parametrico della pompa



Parametrizzazione geometrica

Codice calcolo NSI s.r.l.



$$r_i = \sqrt{\frac{\int_{r_0}^{r_c} \partial V_{c,i} r^3 dr}{\int_{r_0}^{r_c} \partial V_{c,i} r dr}}$$

$$= \sqrt{\frac{3 \cdot 4r_0^3 + 3r_0^2 r_c + 2r_0 r_c^2 + r_c^3}{2r_0 + r_c}}$$

$$r_e = \sqrt{\frac{\int_{r_2}^{r_3} \partial V_{c,e} r_2^2 r dr + \int_{r_c}^{r_2} \partial V_{c,e} r_3 dr}{\int_{r_c}^{r_3} \partial V_{c,e} r dr}}$$

$$= \sqrt{\frac{3r_c^5 + 10r_2^2 r_3^2 (2r_3 - 3r_c) + 15r_2^4 r_c - 8r_2^5}{10(r_3 - r_c)^2 (2r_3 + r_c)}}$$

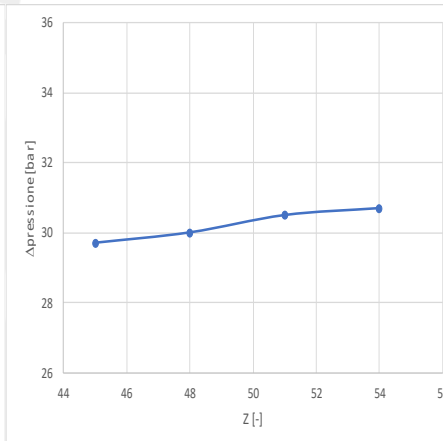
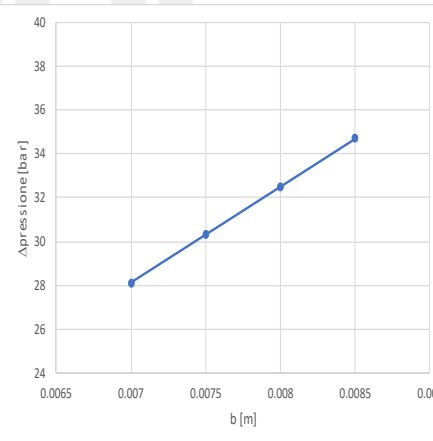
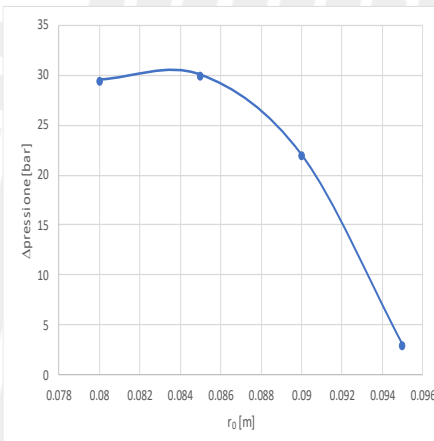
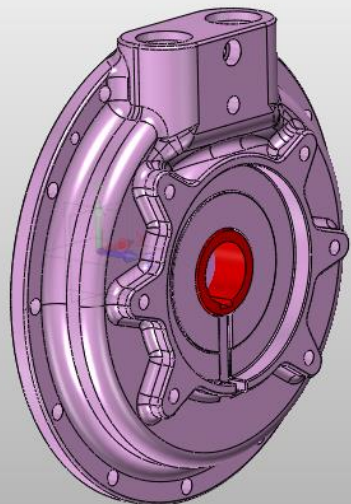
$$\frac{dV_c}{d\theta} = \frac{A_c}{Q + Q_v} [\theta(1 - \phi)(\sigma U_c^2 - \alpha U_i^2) - \Delta g H_T]$$

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else if (C < B && C != 0.0 && rounded){
  Areak_ax = H*deltalk_ax;
  Areak_rad = sqrt(2*B*C-pow(C,2))*deltalk_rad;
  Areak_dxdr = deltalk_ax*deltalk_rad;
  Perimeterlk = 2*H+2*deltalk_ax+2*sqrt(2*B*C-pow(C,2))+2*deltalk_rad;
  Perimeterlk_v = 2*deltalk_ax+2*deltalk_rad;
}
else if (C < B && C != 0.0 && !(rounded)){
  Areak_ax = H*deltalk_ax;
  Areak_rad = B*deltalk_rad;
  Areak_dxdr = deltalk_ax*deltalk_rad;
  Perimeterlk = 2*H+2*deltalk_ax+2*B+2*deltalk_rad;
  Perimeterlk_v = 2*deltalk_ax+2*deltalk_rad;
}
else if (C >= B){
  Areak_ax = H*deltalk_ax;
  Areak_rad = B*deltalk_rad;
  Areak_dxdr = deltalk_ax*deltalk_rad;
  Perimeterlk = 2*H+2*deltalk_ax+2*B+2*deltalk_rad;
  Perimeterlk_v = 2*deltalk_ax+2*deltalk_rad;
}
d_hyd = 4.0*(Areak_ax+Areak_rad+Areak_dxdr)/(Perimeterlk);
D_hyd = 4.0*(Area_v+Areak_ax+Areak_rad+Areak_dxdr)/(Perimeter_v+Perimeterlk_v);
Beta = d_hyd/D_hyd;
L1 = Rg_v*dtheta_pitch/2.0;
L2 = Rg_v*dtheta_pitch/2.0;
    
```

CAD-3D

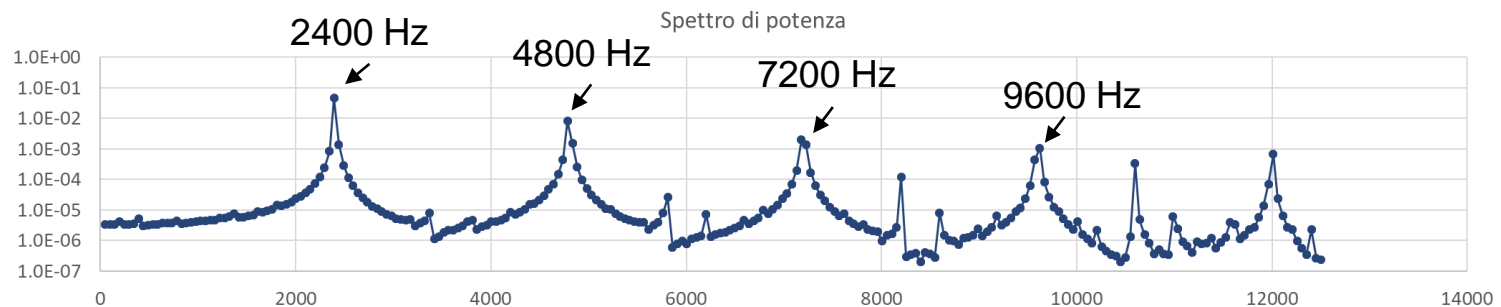
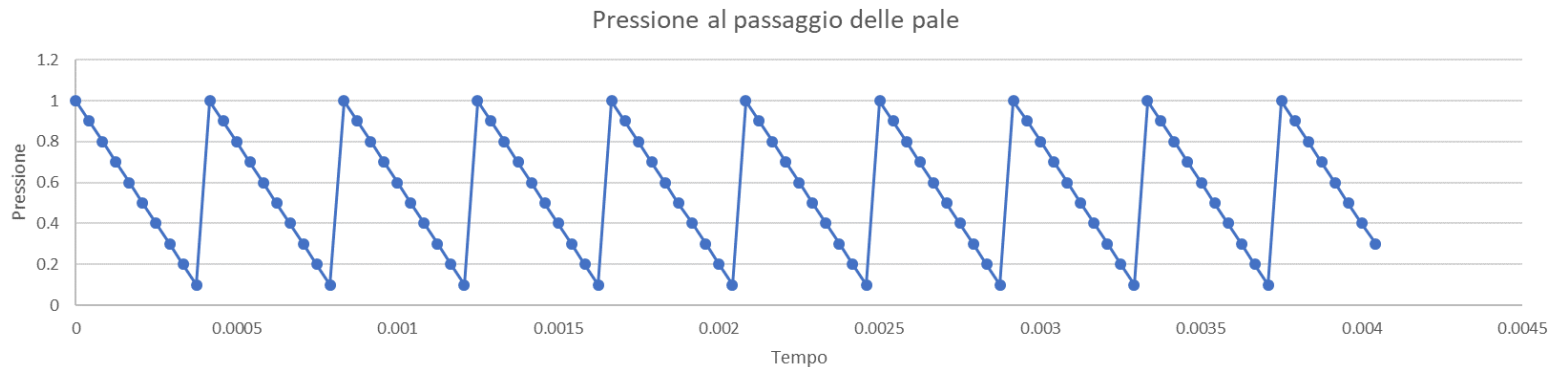
Valutazione delle relazioni tra geometria e prestazioni





Modifica spaziatura pale

- Il passaggio delle pale può essere approssimato con una onda come in figura:





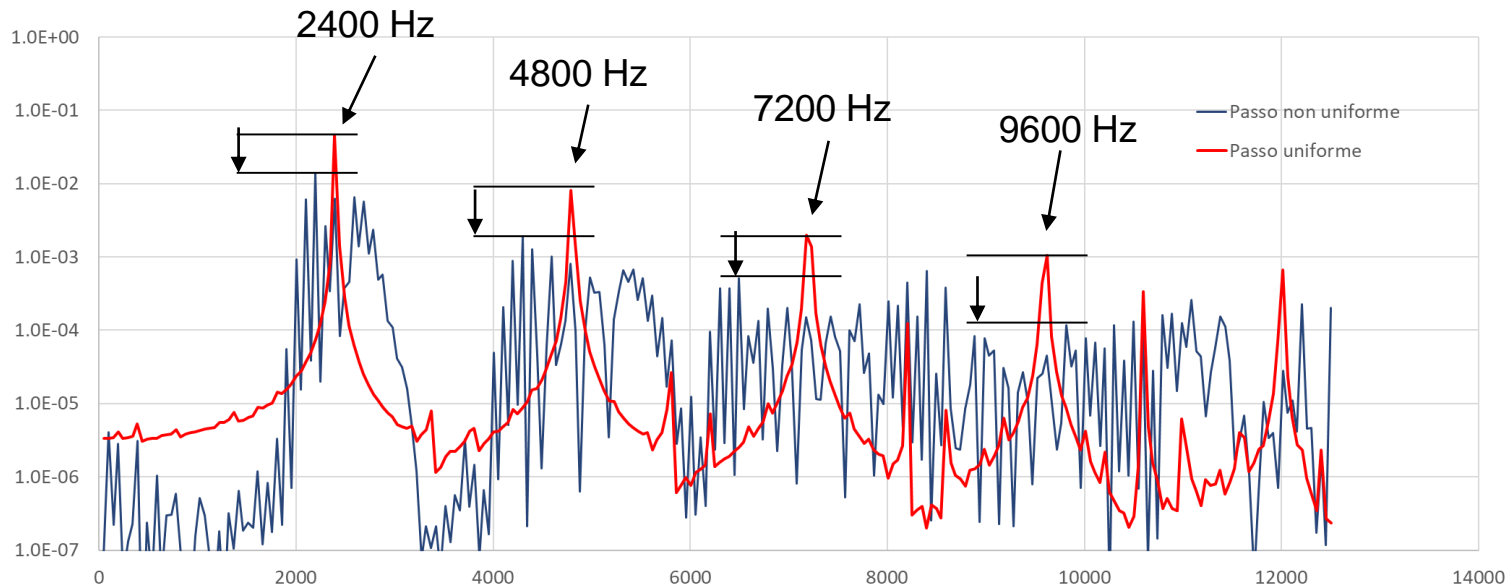
Modifica spaziatura pale

- Le 48 pale sono equispaziate con un passo pari a 7.5° . Con la nuova spaziatura il passo è compreso nel range $6.5^\circ \div 8.5^\circ$;
- Questo introduce una «modulazione in fase» del segnale di rumore tonale che distribuisce la potenza su un range ampio di frequenze abbassando i picchi.



Modifica spaziatura pale

- Il risultato: una riduzione della SPL sulle principali armoniche di almeno 5 dB.





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