

Calcolo regione di stabilità metodo instabile

```
> EQ1 := z+sqrt(1+z^2) ;
EQ2 := z-sqrt(1+z^2) ;
```

$$EQ1 := z + \sqrt{z^2 + 1}$$

$$EQ2 := z - \sqrt{z^2 + 1}$$

(1)

```
> expand(rho*exp(I*theta)) assuming theta::real ;
      rho e^{I\theta}
```

(2)

```
> EQ1bis := subs(z=x+I*y,EQ1-z=cos(theta)+I*sin(theta)-z) ;
```

$$EQ1bis := \sqrt{(x + Iy)^2 + 1} = \cos(\theta) + I \sin(\theta) - x - Iy$$

(3)

```
> EQ1tris := simplify(rhs(EQ1bis)^2-lhs(EQ1bis)^2) ;
```

$$EQ1tris := 2 I \cos(\theta) \sin(\theta) - 2 I \cos(\theta) y - 2 I \sin(\theta) x + 2 \cos(\theta)^2 - 2 \cos(\theta) x + 2 \sin(\theta) y - 2$$

(4)

```
> EQ1tris_conj := subs(I=-I,EQ1tris) ;
```

$$EQ1tris_conj := -2 I \cos(\theta) \sin(\theta) + 2 I \cos(\theta) y + 2 I \sin(\theta) x + 2 \cos(\theta)^2 - 2 \cos(\theta) x + 2 \sin(\theta) y - 2$$

(5)

```
> simplify(solve( {EQ1tris+EQ1tris_conj,
                    simplify((EQ1tris-EQ1tris_conj)/I)}, {x,y} ) ) ;
      {x=0, y=sin(theta)}
```

(6)

Calcolo regione di stabilità metodo stabile

```
> SOL := solve( beta^2-(1+3/2*z)*beta+z/2, {beta} ) ;
```

$$SOL := \left\{ \beta = \frac{3}{4} z + \frac{1}{2} + \frac{1}{4} \sqrt{9 z^2 + 4 z + 4} \right\}, \left\{ \beta = \frac{3}{4} z + \frac{1}{2} - \frac{1}{4} \sqrt{9 z^2 + 4 z + 4} \right\}$$

(7)

```
> subs(z=x+I*y,subs(SOL[1],beta)=cos(theta)+I*sin(theta)) ;
```

$$\frac{3}{4} x + \frac{3}{4} I y + \frac{1}{2} + \frac{1}{4} \sqrt{9 (x + Iy)^2 + 4 x + 4 I y + 4} = \cos(\theta) + I \sin(\theta)$$

(8)

```
> tmp := (3/4)*x+(3/4*I)*y+1/2 ;
```

$$tmp := \frac{3}{4} x + \frac{3}{4} I y + \frac{1}{2}$$

(9)

```
> EQ := subs(z=x+I*y,subs(SOL[1],beta)-tmp=cos(theta)+I*sin(theta)-tmp) ;
```

$$EQ := \frac{1}{4} \sqrt{9 (x + Iy)^2 + 4 x + 4 I y + 4} = \cos(\theta) + I \sin(\theta) - \frac{3}{4} x - \frac{3}{4} I y - \frac{1}{2}$$

(10)

```
> EQbis := simplify(rhs(EQ)^2-lhs(EQ)^2) ;
```

$$EQbis := 2 I \cos(\theta) \sin(\theta) - \frac{3}{2} I \sin(\theta) x - I \sin(\theta) + \frac{3}{2} \sin(\theta) y + 2 \cos(\theta)^2 - 1 - \frac{3}{2} I \cos(\theta) y + \frac{1}{2} I y - \frac{3}{2} \cos(\theta) x - \cos(\theta) + \frac{1}{2} x$$

(11)

$$\begin{aligned}
 & \text{> EQ1bis_conj} := \text{subs}(\text{I}=-\text{I}, \text{EQbis}) ; \\
 \text{EQ1bis_conj} &:= -2 \text{I} \cos(\theta) \sin(\theta) + \frac{3}{2} \text{I} \sin(\theta) x + \text{I} \sin(\theta) + \frac{3}{2} \sin(\theta) y + 2 \cos(\theta)^2 \\
 & - 1 + \frac{3}{2} \text{I} \cos(\theta) y - \frac{1}{2} \text{I} y - \frac{3}{2} \cos(\theta) x - \cos(\theta) + \frac{1}{2} x
 \end{aligned} \tag{12}$$

$$\begin{aligned}
 & \text{> simplify(solve(\{EQbis+EQ1bis_conj,} \\
 & \quad \text{simplify((EQbis-EQ1bis_conj)/I)\}, \{x,y\})) ; \\
 & \left\{ x = \frac{2 (\cos(\theta)^2 - 2 \cos(\theta) + 1)}{-5 + 3 \cos(\theta)}, y = \frac{2 \sin(\theta) (\cos(\theta) - 2)}{-5 + 3 \cos(\theta)} \right\}
 \end{aligned} \tag{13}$$