Rational expressions in $\sin u$ and $\cos u$ can always be handled by the substitution $\boxed{t = \tan\frac{u}{2}}$ (sometimes simpler sub's may apply). To carry this out in practice, we need to express $\sin u$ and $\cos u$ in terms of $t = \tan\frac{u}{2}$, which requires juggling some trig identities

$$\tan\frac{u}{2} = t$$

from tan to cos via Pythagoras

$$\underbrace{1+\tan^2\frac{u}{2}}_{=1/\cos^2\frac{u}{2}} = 1+t^2$$

So $\cos^2\frac{u}{2} = \frac{1}{1+t^2}$

use double angle formula

$$\cos u = 2\cos^2\frac{u}{2} - 1 = \frac{2}{1+t^2} - 1 = \frac{1-t^2}{1+t^2}$$

Result:

$$\boxed{\cos u = \frac{1-t^2}{1+t^2}}$$

Then

$$\sin u = 2\sin\frac{u}{2}\cos\frac{u}{2} = 2\tan\frac{u}{2}\cdot\cos^2\frac{u}{2} = 2t\cdot\frac{1}{1+t^2}$$

double angle formula

Result: $\boxed{\sin u = \frac{2t}{1+t^2}}$

Of course $\boxed{du = \frac{2\,dt}{1+t^2}}$

from differentiating $u = 2\arctan t$