Thm Differentiation Rules for Vector Functions

Let \( \vec{u}(t) \) & \( \vec{v}(t) \) be differentiable, \( \vec{c} \) constant vector, \( c \) any scalar, \& \( f(t) \) any differentiable function.

1) Constant Function Rule: \( \frac{d}{dt} \vec{c} = 0 \)

2) Scalar Multiple Rules: \( \frac{d}{dt} [c \vec{u}(t)] = c \vec{u}'(t) \)
\( \frac{d}{dt} [f(t) \vec{u}(t)] = f'(t) \vec{u}(t) + f(t) \vec{u}'(t) \)

3) Sum Rule: \( \frac{d}{dt} [\vec{u}(t) + \vec{v}(t)] = \vec{u}'(t) + \vec{v}'(t) \)

4) Difference Rule: \( \frac{d}{dt} [\vec{u}(t) - \vec{v}(t)] = \vec{u}'(t) - \vec{v}'(t) \)

5) Dot Product Rule: \( \frac{d}{dt} [\vec{u}(t) \cdot \vec{v}(t)] = \vec{u}'(t) \cdot \vec{v}(t) + \vec{u}(t) \cdot \vec{v}'(t) \)

6) Cross Product Rule: \( \frac{d}{dt} [\vec{u}(t) \times \vec{v}(t)] = \vec{u}'(t) \times \vec{v}(t) + \vec{u}(t) \times \vec{v}'(t) \)

7) Chain Rule: \( \frac{d}{dt} [\vec{u}(f(t))] = f'(t) \vec{u}'(f(t)) \)