Given position, velocity and acceleration, $\boldsymbol{p}, \boldsymbol{v}, \boldsymbol{a} \in \mathbb{R}^2$, where $\boldsymbol{a} \neq \boldsymbol{0}$ Dishonored's movement system works as follows:

Algorithm 1 MOVEMENT($\Delta t, s, f$)

1: $\mathsf{MaxSpeed} = 400 \cdot s$
2: $\mathsf{MaxAccel} = 2000 \cdot s$
3: $\boldsymbol{d} = \boldsymbol{a} / |\boldsymbol{a}|$
4: **if** $|\boldsymbol{a}| > \mathsf{MaxAccel}$ **then**
5: $\quad\boldsymbol{a} = \mathsf{MaxAccel} \cdot \boldsymbol{d}$ // *Limit acceleration to MaxAccel*
6: $\boldsymbol{v} \mathrel{-}= \Delta t \cdot f \cdot (\boldsymbol{v} - |\boldsymbol{v}| \cdot \boldsymbol{d})$ // *Friction*
7: $\boldsymbol{v} \mathrel{+}= \Delta t \cdot \boldsymbol{a}$ // *Acceleration*
8: **if** $|\boldsymbol{v}| > \mathsf{MaxSpeed}$ **then**
9: $\quad\boldsymbol{v} = \mathsf{MaxSpeed} \cdot \boldsymbol{v} / |\boldsymbol{v}|$ // *Limit velocity to MaxSpeed*
10: $\boldsymbol{p} \mathrel{+}= \Delta t \cdot \boldsymbol{v}$ // *Movement*

Here $\Delta t, s, f \in \mathbb{R}$ represent respectively the delta time (in seconds), the speed scale, and friction constant. The friction constant $f = 8$, and the speed scale s depends on the type of movement. Some relevant values are $s = 1$ when walking, $s = 1.5$ when sprinting, and $s = 1.95$ when agility sprinting. We can generally assume $|\boldsymbol{a}| = 2000 \leq \mathsf{MaxAccel}$.

Note that when $\Delta t = \frac{1}{f} = \frac{1}{8}$, they cancel each other out during the friction step (Line 6), where we simply get $\boldsymbol{v} \mathrel{-}= \boldsymbol{v} - |\boldsymbol{v}| \cdot \boldsymbol{d}$, which is equivalent to $\boldsymbol{v} = |\boldsymbol{v}| \cdot \boldsymbol{d}$, i.e., all previous speed gets redirected in the direction we are currently moving. This property is unique to 8 FPS.

It is possible to achieve something similar at other frame rates if we take into account the acceleration step (Line 7), by solving the equation

$$m \cdot \boldsymbol{u} = \boldsymbol{v} - \Delta t \cdot f \cdot (\boldsymbol{v} - |\boldsymbol{v}| \cdot \boldsymbol{d}) + \Delta t \cdot 2000 \cdot \boldsymbol{d},$$

for m and $\boldsymbol{d}$ where $|\boldsymbol{d}| = 1$ in order to move in direction $\boldsymbol{u}$.

If we make the simplifying assumption that $\boldsymbol{v} = \mathsf{MaxSpeed} \cdot \boldsymbol{w}$ for some unit vector $\boldsymbol{w}$, we can further simplify the equation to

$$\begin{aligned} m \cdot \boldsymbol{u} &= \mathsf{MaxSpeed} \cdot \boldsymbol{w} - \Delta t \cdot f \cdot \mathsf{MaxSpeed} \cdot (\boldsymbol{w} - \boldsymbol{d}) + \Delta t \cdot 2000 \cdot \boldsymbol{d} \\ &= 400 \cdot s \cdot \boldsymbol{w} - \Delta t \cdot f \cdot 400 \cdot s \cdot (\boldsymbol{w} - \boldsymbol{d}) + \Delta t \cdot 2000 \cdot \boldsymbol{d} \\ \iff \frac{m}{400 \cdot s} \cdot \boldsymbol{u} &= \boldsymbol{w} - \Delta t \cdot f \cdot (\boldsymbol{w} - \boldsymbol{d}) + \frac{5}{s} \cdot \Delta t \cdot \boldsymbol{d}. \end{aligned}$$

We let $m' = \frac{m}{400 \cdot s}$ and $a = \frac{5}{s}$, and end up with the final equation

$$m' \cdot \boldsymbol{u} = \boldsymbol{w} - \Delta t \cdot f \cdot (\boldsymbol{w} - \boldsymbol{d}) + a \cdot \Delta t \cdot \boldsymbol{d}.$$

It is easy to rearrange in order to find

$$\boldsymbol{d} = \frac{m' \cdot \boldsymbol{u} + (\Delta t \cdot f - 1) \cdot \boldsymbol{w}}{\Delta t \cdot (a + f)}.$$

Solving for m' is harder but yields

$$m' = \sqrt{(\Delta t \cdot (a + f))^2 - ((\Delta t \cdot f - 1) \cdot \boldsymbol{u} \cdot \boldsymbol{w'})^2} - (\Delta t \cdot f - 1) \cdot \boldsymbol{u} \cdot \boldsymbol{w},$$

where $\boldsymbol{w'} = (-w_2, w_1)$.

If we want to simply turn an absolute amount, we can fix $\boldsymbol{w} = (1, 0)$, which simplifies the above equations to

$$\boldsymbol{d} = \frac{m' \cdot \boldsymbol{u} + (\Delta t \cdot f - 1, 0)}{\Delta t \cdot (a + f)},$$

and

$$m' = \sqrt{(\Delta t \cdot (a + f))^2 - ((\Delta t \cdot f - 1) \cdot u_2)^2} - (\Delta t \cdot f - 1) \cdot u_1.$$