CLAIMS

1. A simulation system, comprising:

a body;

a linear motor including a sliding mass, the linear motor attached to the body; and

a controller in communication with the linear motor and controlling movement of the sliding mass, by controlling a current of the linear motor using pulse-width modulation, to thereby produce a force on the body that simulates a haptic effect,

wherein the controller is configured to simulate the haptic effect to include one or more predetermined force vs. time profiles, each characterized by a respective recoil impulse.

2. The simulation system of claim 1, wherein the controller is configured to control the linear motor to impart to the sliding mass a force vs. time profile corresponding to an actual force vs. time profile of a firearm projectile.

3. The simulation system of claim 1, wherein the controller is configured to control the linear motor to impart to the sliding mass a force vs. time profile that differs from an actual force vs. time profile of a firearm projectile, but has a recoil impulse substantially equal to an impulse associated with the actual force vs. time profile of the firearm projectile.

4. The simulation system of claim 1, wherein the controller is configured to control the linear motor to impart to the sliding mass a force vs. time profile that includes a braking force that decelerates the sliding mass.

5. The simulation system of claim 4, wherein the controller is configured to generate the braking force by reversing a driving magnetic field initially used to accelerate the sliding mass.

6. The simulation system of claim 1, further comprising:

a mechanical stop,

wherein the controller controls the linear motor to drive the sliding mass against the mechanical stop to generate an impact event having a predetermined impulse value.

7. The simulation system of claim 6, wherein the controller is configured to control the linear motor to impart a force vs. time profile to the sliding mass such that the impact event has a peak force that differs from a peak force of an actual force vs. time profile of a firearm projectile by no more than fifty percent of the peak force of the impact event.

8. The simulation system of claim 6, wherein the controller is configured to control the linear motor to impart to the sliding mass a force vs. time profile that includes:

a braking force that decelerates the sliding mass; and

an impact event.

9. The simulation system of claim 8, wherein the controller is configured to generate the haptic effect to have two or more parts, wherein each part includes one or more of a braking force and an impact event.

10. The simulation system of claim 8, wherein the controller is configured to generate the haptic effect to have two or more parts, wherein the first part includes a braking force and an impact event, wherein the braking force decelerates the sliding mass before the impact event.

11. The simulation system of claim 1, further comprising:

a sensor that measures a frequency of magnetic field fluctuations arising due to motion of magnets associated with the sliding mass,

wherein the controller is further configured to determine position, velocity, and acceleration, of the sliding mass based on the measured frequency of magnetic field fluctuations.

12. The simulation system of claim 11, wherein the controller is further configured to:

control time dependent magnetic field strengths generated by the linear motor, to achieve a predetermined position, velocity, and acceleration, of the sliding mass, based on the measured frequency of magnetic field fluctuations.

13. A simulation system, comprising:

a body;

a linear motor including a sliding mass, the linear motor attached to the body;

a mechanical stop;

a controller in communication with the linear motor and controlling movement of the sliding mass, by controlling a current of the linear motor using pulse-width modulation,

wherein the controller communicates an impulse value to the linear motor and the motor drives the sliding mass against the mechanical stop to generate an impact event that produces a force on the body that simulates a haptic effect, the impact event having a predetermined impulse value.

14. The system of claim 13, wherein the controller is configured to control the linear motor to impart a force vs. time profile to the sliding mass that includes:

a braking force that decelerates the sliding mass; and

an impact event.

15. A method of controlling a simulation system including a body, a linear motor attached to the body, the linear motor including a sliding mass, the method comprising:

controlling the linear motor, by controlling a current of the linear motor using pulse-width modulation, to impart a force vs. time profile to the sliding mass to thereby produce a force on the body that simulates a haptic effect,

wherein the simulated haptic effect includes one or more predetermined force vs. time profiles, each characterized by a respective recoil impulse.

16. The method of claim 15, further comprising:

controlling the linear motor to impart to the sliding mass a force vs. time profile corresponding to an actual force vs. time profile of a firearm projectile.

17. The method of claim 15, further comprising:

controlling the linear motor to impart to the sliding mass a force vs. time profile that differs from an actual force vs. time profile of a firearm projectile, but has a recoil impulse substantially equal to an impulse associated with the actual force vs. time profile of the firearm projectile.

18. The method of claim 15, further comprising:

controlling the linear motor to impart to the sliding mass a force vs. time profile that includes a braking force that decelerates the sliding mass.

19. The method of claim 15, further comprising:

controlling the linear motor to drive the sliding mass against a mechanical stop of the system to thereby generate an impact event having a predetermined impulse value.

20. The method of claim 15, further comprising:

measuring a frequency of magnetic field fluctuations arising due to motion of magnets associated with the sliding mass;

determining position, velocity, and acceleration, of the sliding mass based on the measured frequency of magnetic field fluctuations; and

controlling time dependent magnetic field strengths of the linear motor, to achieve a predetermined position, velocity, and acceleration of the sliding mass, based on the measured frequency of magnetic field fluctuations.