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Pattern based shear thickening fluid object control method and mechanism

Abstract

A head unit system for controlling motion of an object includes a secondary object sensor and a head unit that includes shear thickening fluid (STF) and a chamber configured to contain the STF. The chamber further includes a front channel and a back channel. The head unit further includes a piston housed at least partially radially within the piston compartment and separating the back channel and the front channel. The piston includes a first piston bypass and a second piston bypass to control flow of the STF between opposite sides of the piston. The chamber further includes a set of fluid flow sensors and a set of fluid manipulation emitters to control the flow of the STF to cause selection of one of a variety of shear rates for the STF within the chamber to control motion of the object with regards to a secondary object.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) The present U.S. Utility patent application claims priority pursuant to 35 U.S.C. § 120 as a continuation of U.S. Utility application Ser. No. 17/564,639, entitled “PATTERN BASED SHEAR THICKENING FLUID OBJECT CONTROL METHOD AND MECHANISM,” filed Dec. 29, 2021, allowed, which claims priority pursuant to 35 U.S.C. § 119 (e) to U.S. Provisional Application No. 63/284,266, entitled “SHEAR THICKENING FLUID CONTROL METHOD AND MECHANISM”, filed Nov. 30, 2021, all of which are hereby incorporated herein by reference in their entirety and made part of the present U.S. Utility patent application for all purposes.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT
(1) Not Applicable.
INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC
(2) Not Applicable.
BACKGROUND OF THE INVENTION
Technical Field of the Invention
(3) This invention relates generally to systems that measure and control mechanical movement and more particularly to sensing and controlling of a linear and/or rotary movement mechanism that includes a chamber with dilatant fluid (e.g., a shear thickening fluid).
Description of Related Art
(4) Many mechanical mechanisms are subject to undesired movement that can lead to annoying sounds, property damage and/or loss, and personal injury and even death. Desired and undesired movements of the mechanical mechanisms may involve a wide range of forces. A need exists to control the wide range of forces to solve these problems.

Description

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

(1) FIG. **1**A is a schematic block diagram of an embodiment of a mechanical and computing system in accordance with the present invention;

(2) FIG. **1**B is a graph of viscosity vs. shear rate for an aspect of an embodiment of a mechanical and computing system in accordance with the present invention;

(3) FIG. **1**C is a graph of plunger velocity vs. force applied to the plunger for an aspect of an embodiment of a mechanical and computing system in accordance with the present invention;

(4) FIG. **2**A is a schematic block diagram of an embodiment of a computing entity of a computing system in accordance with the present invention;

(5) FIG. **2**B is a schematic block diagram of an embodiment of a computing device of a computing system in accordance with the present invention;

(6) FIG. **3** is a schematic block diagram of another embodiment of a computing device of a computing system in accordance with the present invention;

(7) FIG. **4** is a schematic block diagram of an embodiment of an environment sensor module of a computing system in accordance with the present invention;

(8) FIGS. **5**A-**5**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects in accordance with the present invention;

(9) FIGS. **6**A-**6**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects in accordance with the present invention;

(10) FIGS. **7**A-**7**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects in accordance with the present invention;

(11) FIGS. **8**A-**8**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects in accordance with the present invention; and

(12) FIGS. **9**A-**9**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

(13) FIG. **1**A is a schematic block diagram of an embodiment of a mechanical and computing system that includes a set of head units **10-1** through **10**-N, objects **12-1** through **12-3**, computing entities **20-1** through **20**-N associated with the head units **10-1** through **10**-N, and a computing entity **22**. The objects include any object that has mass and moves. Examples of an object include a door, an aircraft wing, a portion of a building support mechanism, and a particular drivetrain, etc.

(14) The cross-sectional view of FIG. **1**A illustrates a head unit that includes a chamber **16**, a piston **36**, a plunger **28**, a plunger bushing **32**, and a chamber bypass **40**. The chamber **16** contains a shear thickening fluid (STF) **42**. The chamber **16** includes a back channel **24** and a front channel **26**, where the piston partitions the back channel **24** and the front channel **26**. The piston **36** travels axially within the chamber **16**. The chamber **16** may be a cylinder or any other shape that enables movement of the piston **36** and compression of the STF **42**. The STF **42** is discussed in greater detail with reference to FIGS. **1**B and **1**C.

(15) The plunger bushing **32** guides the plunger **28** into the chamber **16** in response to force from the object **12-1**. The plunger bushing **32** facilitates containment of the STF within the chamber **16**. The plunger bushing **32** remains in a fixed position relative to the chamber **16** when the force from the object moves the piston **36** within the chamber **16**. In an embodiment the plunger bushing **32** includes an O-ring between the plunger bushing **32** and the chamber **16**. In another embodiment the plunger bushing **32** includes an O-ring between the plunger bushing **32** and the plunger **28**.

(16) The piston **36** includes a piston bypass **38** between opposite sides of the piston to facilitate flow of a portion the STF between the opposite sides of the piston (e.g., between the back channel **24** and the front channel **26**) when the piston travels through the chamber in an inward or an outward direction.
(17) Alternatively, or in addition to, the chamber bypass **40** is configured between opposite ends of the chamber **16**, wherein the chamber bypass **40** facilitates flow of a portion of the STF between the opposite ends of the chamber when the piston travels through the chamber in the inward or outward direction (e.g., between the back channel **24** and the front channel **26**).
(18) In alternative embodiments, the piston bypass **38** and the chamber bypass **40** includes mechanisms to enable STF flow in one direction and not an opposite direction. In further alternative embodiments, a control valve within the piston bypass **38** and/or the chamber bypass **40** controls the STF flow between the back channel **24** and the front channel **26**. Each bypass includes one or more of a one-way check valve and a variable flow valve.
(19) The plunger **28** is operably coupled to a corresponding object by one of a variety of approaches. A first approach includes a direct connection of the plunger **28** to the object **12-1** such that linear motion in any direction couples from the object **12-1** to the plunger **28**. A second approach includes the plunger **28** coupled to a cap **44** which receives a one way force from a strike **48** attached to the object **12-2**. A third approach includes a pushcap **46** that receives a force from a rotary-to-linear motion conversion component that is attached to the object **12-3**. In an example, the object **12-3** is connected to a camshaft **110** which turns a cam **109** to strike the pushcap **46**.
(20) In an embodiment, two or more of the head units are coupled by a head unit connector **112**. When so connected, actuation of a piston in a first head unit is essentially replicated in a piston of a second head unit. The head unit connector **112** includes a mechanical element between plungers of the two or more head units and/or direct connection of two or more plungers to a common object. For example, plunger **28** of head unit **10-1** and plunger **28** of head unit **10-2** are directly connected to object **12-1** when utilizing a direct connection.
(21) Further associated with each head unit is a set of emitters and a set of sensors. For example, head unit **10**-N includes a set of emitters **114**-N-**1** through **114**-N-M and a set of sensors **116**-N-**1** through **116**-N-M. Emitters includes any type of energy and or field emitting device to affect the STF, either directly or indirectly via other nanoparticles suspended in the STF. Examples of emitter categories include light, audio, electric field, magnetic field, wireless field, etc. Specific examples of fluid manipulation emitters include a variable flow valve associated with a bypass or injector or similar, a mechanical vibration generator, an image generator, a light emitter, an audio transducer, a speaker, an ultrasonic sound transducer, an electric field generator, a magnetic field generator, and a radio frequency wireless field transmitter. Specific examples of magnetic field emitters include a Helmholtz coil, a Maxwell coil, a permanent magnet, a solenoid, a superconducting electromagnet, and a radio frequency transmitting coil.
(22) Sensors include any type of energy and/or field sensing device to output a signal that represents a reaction, motion or position of the STF. Examples of sensor categories include bypass valve position, mechanical position, image, light, audio, electric field, magnetic field, wireless field, etc. Specific examples of fluid flow sensors include a valve opening detector associated with the chamber **16** or any type of bypass (e.g., piston bypass **38**, chamber bypass **40**, a reservoir injector, or similar), a mechanical position sensor, an image sensor, a light sensor, an audio sensor, a microphone, an ultrasonic sound sensor, an electric field sensor, a magnetic field sensor, and a radio frequency wireless field sensor. Specific examples of magnetic field sensors include a Hall effect sensor, a magnetic coil, a rotating coil magnetometer, an inductive pickup coil, an optical magnetometry sensor, a nuclear magnetic resonance sensor, and a caesium vapor magnetometer.
(23) The computing entities **20-1** through **20**-N are discussed in detail with reference to FIG. **2**A. The computing entity **22** includes a control module **30** and a chamber database **34** to facilitate storage of history of operation, desired operations, and other aspects of the system.

(24) In an example of operation, the head unit **10-1** controls motion of the object **12-1** and includes the chamber **16** filled at least in part with the shear thickening fluid **42**, the piston **36** housed at least partially radially within the chamber **16**, and the piston **36** is configured to exert pressure against the shear thickening fluid **42** in response to movement of the piston **36** from a force applied to the piston from the object **12-1**. The movement of the piston **36** includes one of traveling through the chamber **16** in an inward direction or traveling through the chamber **16** in an outward direction. The STF is configured to have a decreasing viscosity in response to a first range of shear rates and an increasing viscosity in response to a second range of shear rates.
(25) The shear thickening fluid **42** (e.g., dilatant non-Newtonian fluid) has nanoparticles of a specific dimension that are mixed in a carrier fluid or solvent. Force applied to the shear thickening fluid **42** results in these nanoparticles stacking up, thus stiffening and acting more like a solid than a flowable liquid when a shear threshold is reached. In particular, viscosity of the shear thickening fluid **42** rises significantly when shear rate is increased to a point of the shear threshold. The relationship between viscosity and shear rates is discussed in greater detail with reference to FIGS. **1**A and **1**B.
(26) In another example of operation, the object **12-1** applies an inward motion force on the plunger **28** which moves the piston **36** in words within the chamber **16**. As the piston moves inward, shear rate of the shear thickening fluid **42** changes. A sensor **116-1-1** associated with the chamber **16** of the head unit **10-1** outputs chamber I/O **160** to the computing entity **20-1**, where the chamber I/O **160** includes a movement data associated with the STF **42** as a result of the piston **36** moving inwards. Having received the chamber I/O **160**, the computing entity **20-1** interprets the chamber I/O **160** to reproduce the movement data.
(27) The computing entity **20-1** outputs the movement data as a system message **162** to the computing entity **22**. The control module **30** stores the movement data in the chamber database **34** and interprets the movement data to determine whether to dynamically adjust the viscosity of the shear thickening fluid. Dynamic adjustment of the viscosity results in dynamic control of the movement of the piston **36**, the plunger **28**, and ultimately the object **12-1**. Adjustment of the viscosity affects velocity, acceleration, and position of the piston **36**.
(28) The control module **30** determines whether to adjust the viscosity based on one or more desired controls of the object **12-1**. The desired controls include accelerating, deaccelerating, abruptly stopping, continuing on a current trajectory, continuing at a constant velocity, or any other movement control. For example, the control module **30** determines to abruptly stop the movement of the object **12-1** when the object **12-1** is a door and the door is detected to be closing at a rate above a maximum closing rate threshold level and when the expected shear rate versus viscosity of the shear thickening fluid **42** requires modification (e.g., boost the viscosity now to slow the door from closing too quickly).
(29) When determining to modify the viscosity, the control module **30** outputs a system message **162** to the computing entity **20-1**, where the system message **162** includes instructions to immediately boost the viscosity beyond the expected shear rate versus viscosity of the shear thickening fluid **42**. Alternatively, the system message **162** includes specific information on the relationship of viscosity versus shear rate.
(30) Having received the system message **162**, the computing entity **20-1** determines a set of adjustments to make with regards to the shear thickening fluid **42** within the chamber **16**. The set of adjustments includes one or more of adjusting STF **42** flow through the chamber bypass **40**, adjusting STF **42** flow through the piston bypass **38**, and activating an emitter of a set of emitters **114-1-1** through **114**-N-**1**. The flow adjustments include regulating within a flow range, stopping, starting, and allowing in one particular direction. For example, the computing entity **20-1** determines to activate emitter **114-1-1** to produce a magnetic field such as to interact with magnetic nanoparticles within the STF **42** to raise the viscosity. The computing entity **20-1** issues another chamber I/O **160** to the emitter **114-1-1** to initiate a magnetic influence process to boost the

viscosity of the STF **42**.

(31) In an alternative embodiment, the computing entity **22** issues another system message **162** to two or more computing entities (e.g., **20-1** and **20-2**) to boost the viscosity for corresponding head units **10-1** and **10-2** when the head unit connector **112** connects head units **10-1** and **10-2** and both head units are controlling the motion of the object **12-1**. For instance, one of the head units informs the computing entity **22** that the object **12-1** is moving too quickly inward and the predicted stopping power of the expected viscosity versus shear rate of the STF **42** of the head unit, even when boosted, will not be enough to slow the object **12-1** to a desired velocity or position. When informed that one head unit, even with a modified viscosity, is not enough to control the object **12-1**, the control module **30** determines how many other head units (e.g., connected via the head unit connector **112**) to apply and to dynamically modify the viscosity.

(32) In yet another alternative embodiment, the computing entity **22** issues a series of system messages **162** to a set of computing entities associated with a corresponding set of head units to produce a cascading effect of altering of the viscosity of the STF **42** of each of the chambers **16** associated with the set of head units. For example, 3 head units are controlled by 3 corresponding computing entities to adjust viscosity in a time cascaded manner. For instance, head unit **10-1** abruptly changes the viscosity to attempt to slow the object **12-1** followed seconds later by head unit **10-2** abruptly changing the viscosity to attempt to further slow the object **12-1**, followed seconds later by head unit **12-3** abruptly changing the viscosity to attempt to further slow the object **12-1**.

(33) In a still further alternative embodiment, the computing entity **22** conditionally issues each message of the series of system messages **162** to the set of computing entities associated with the corresponding set of head units to produce the cascading effect of altering of the viscosity of the STF **42** of each of the chambers **16** associated with the set of head units only when a most recent adaptation of viscosity is not enough to slow the object **12-1** with desired results. For example, the 3 head units are controlled by the 3 corresponding computing entities to adjust viscosity in a conditional time cascaded manner. For instance, head unit **10-1** abruptly changes the viscosity to attempt to slow the object **12-1** followed seconds later by head unit **10-2** abruptly changing the viscosity if head unit **10-1** was unsuccessful to attempt to further slow the object **12-1**, followed seconds later by head unit **12-3** abruptly changing the viscosity if head unit **10-2** was unsuccessful to attempt to further slow the object **12-1**.

(34) FIG. **1**B is a graph of viscosity vs. shear rate for an aspect of an embodiment of a mechanical and computing system that includes a chamber, a shear thickening fluid, and a piston that moves through the chamber applying forces on the shear thickening fluid. The shear thickening fluid includes a non-Newtonian fluid since the relationship between shear rate and viscosity is nonlinear.

(35) A relationship between compressive impulse (e.g., shear rate) and the viscosity of the shear thickening fluid is nonlinear and may comprise one or more inflection points as the piston travels within the chamber in response to different magnitudes of forces and different accelerations. The viscosity of the STF may also be a function of other influences, such as electric fields, acoustical waves, magnetic fields, and other similar influences. As a first example of a response of a shear thickening fluid, a first range of shear rates in zone A has a decreasing viscosity as the shear rate increases and then in a second range of shear rates in zone B the viscosity increases abruptly. As a second example of a response of a diluted shear thickening fluid, the first range of shear rates in zone A extends to a higher level of shear rates with the decreasing viscosity and then in the still higher second range of shear rates in zone B the viscosity increases abruptly similar to that of the shear thickening include.

(36) The shear thickening fluid includes particles within a solvent. Examples of particles of the shear thickening fluid include oxides, calcium carbonate, synthetically occurring minerals, naturally occurring minerals, polymers, or a mixture thereof. Further examples of the particles of the shear thickening fluid include SiO2, polystyrene, or polymethylmethacrylate.

(37) The particles are suspended in a solvent. Example components of the solvent include water, a salt, a surfactant, and a polymer. Further example components of the solvent include ethylene glycol, polyethylene glycol, ethanol, silicon oils, phenyltrimethicone or a mixture thereof. Example particle diameters range from less than 100 μm to less than 1 millimeter. In an instance, the shear thickening fluid is made of silica particles suspended in polyethylene glycol at a volume fraction of approximately 0.57 with the silica particles having an average particle diameter of approximately 446 nm. As a result, the shear thickening fluid exhibits a shear thickening transition at a shear rate of approximately 102-103 s^{-1}.
(38) A volume fraction of particles dispersed within the solvent distinguishes the viscosity versus shear rate of different shear thickening fluids. The viscosity of the STF changes in response to the applied shear stress. At rest and under weak applied shear stress, a STF may have a fairly constant or even slightly decreasing viscosity because the random distribution of particles causes the particles to frequently collide. However, as a greater shear stress is applied so that the shear rate increases, the particles flow in a more streamlined manner. However, as an even greater shear stress is applied so that the shear rate increases further, a hydrodynamic coupling between the particles may overcome the interparticle forces responsible for Brownian motion. The particles may be driven closer together, and the microstructure of the colloidal dispersion may change, so that particles cluster together in hydroclusters.
(39) The viscosity curve of the STF can be fine-tuned through changes in the characteristics of the particles suspended in the solvent. For example, the particles shape, surface chemistry, ionic strength, and size affect the various interparticle forces involved, as does the properties of the solvent. However, in general, hydrodynamic forces dominate at a high shear stress, which also makes the addition of a polymer attached to the particle surface effective in limiting clumping in hydroclusters. Various factors influence this clumping behavior, including, fluid slip, adsorbed ions, surfactants, polymers, surface roughness, graft density (e.g., of a grafted polymer), molecular weight, and solvent, so that the onset of shear thickening can be modified. In general, the onset of shear thickening can be slowed by the introduction of techniques to prevent the clumping of particles. For example, influencing the STF with emissions from an emitter in proximal location to the chamber.
(40) FIG. **1**C is a graph of piston velocity vs. force applied to the piston for an aspect of an embodiment of a mechanical and computing system that includes a chamber, a shear thickening fluid, and a piston that moves through the chamber applying forces on the shear thickening fluid. The shear thickening fluid includes a non-Newtonian fluid since the relationship between shear rate and viscosity is nonlinear.
(41) An example curve for a shear thickening fluid indicates that as more force is applied to the piston in zone A, a higher piston velocity is realized until the corresponding transition to zone B occurs where the shear threshold affect takes hold and the viscosity abruptly increases significantly. When the viscosity increases abruptly, the piston velocity slows back down and may even stop.
(42) Another example curve for a diluted shear thickening fluid indicates that as more force is applied to the piston in zone A, an even higher piston velocity is realized until the corresponding transition to zone B occurs where the shear threshold affect takes hold and the viscosity abruptly increases significantly. When the viscosity increases abruptly, the piston velocity slows back down and may even stop.
(43) FIG. **2**A is a schematic block diagram of an embodiment of the computing entity (e.g., **20-1** through **20**-N; and **22**) of the mechanical and computing system of FIG. **1**. The computing entity includes one or more computing devices **100-1** through **100**-N. A computing device is any electronic device that communicates data, processes data, represents data (e.g., user interface) and/or stores data.
(44) Computing devices include portable computing devices and fixed computing devices. Examples of portable computing devices include an embedded controller, a smart sensor, a social

networking device, a gaming device, a smart phone, a laptop computer, a tablet computer, a video game controller, and/or any other portable device that includes a computing core. Examples of fixed computing devices includes a personal computer, a computer server, a cable set-top box, a fixed display device, an appliance, and industrial controller, a video game counsel, a home entertainment controller, a critical infrastructure controller, and/or any type of home, office or cloud computing equipment that includes a computing core.

(45) FIG. **2**B is a schematic block diagram of an embodiment of a computing device (e.g., **100-1** through **100**-N) of the computing entity of FIG. **2**A that includes one or more computing cores **52-1** through **52**-N, a memory module **102**, a human interface module **18**, an environment sensor module **14**, and an input/output (I/O) module **104**. In alternative embodiments, the human interface module **18**, the environment sensor module **14**, the I/O module **104**, and the memory module **102** may be standalone (e.g., external to the computing device). An embodiment of the computing device is discussed in greater detail with reference to FIG. **3**.

(46) FIG. **3** is a schematic block diagram of another embodiment of the computing device **100-1** of the mechanical and computing system of FIG. **1** that includes the human interface module **18**, the environment sensor module **14**, the computing core **52-1**, the memory module **102**, and the I/O module **104**. The human interface module **18** includes one or more visual output devices **74** (e.g., video graphics display, 3-D viewer, touchscreen, LED, etc.), one or more visual input devices **80** (e.g., a still image camera, a video camera, a 3-D video camera, photocell, etc.), and one or more audio output devices **78** (e.g., speaker(s), headphone jack, a motor, etc.). The human interface module **18** further includes one or more user input devices **76** (e.g., keypad, keyboard, touchscreen, voice to text, a push button, a microphone, a card reader, a door position switch, a biometric input device, etc.) and one or more motion output devices **106** (e.g., servos, motors, lifts, pumps, actuators, anything to get real-world objects to move).

(47) The computing core **52-1** includes a video graphics module **54**, one or more processing modules **50-1** through **50**-N, a memory controller **56**, one or more main memories **58-1** through **58**-N (e.g., RAM), one or more input/output (I/O) device interface modules **62**, an input/output (I/O) controller **60**, and a peripheral interface **64**. A processing module is as defined at the end of the detailed description.

(48) The memory module **102** includes a memory interface module **70** and one or more memory devices, including flash memory devices **92**, hard drive (HD) memory **94**, solid state (SS) memory **96**, and cloud memory **98**. The cloud memory **98** includes an on-line storage system and an on-line backup system.

(49) The I/O module **104** includes a network interface module **72**, a peripheral device interface module **68**, and a universal serial bus (USB) interface module **66**. Each of the I/O device interface module **62**, the peripheral interface **64**, the memory interface module **70**, the network interface module **72**, the peripheral device interface module **68**, and the USB interface modules **66** includes a combination of hardware (e.g., connectors, wiring, etc.) and operational instructions stored on memory (e.g., driver software) that are executed by one or more of the processing modules **50-1** through **50**-N and/or a processing circuit within the particular module.

(50) The I/O module **104** further includes one or more wireless location modems **84** (e.g., global positioning satellite (GPS), Wi-Fi, angle of arrival, time difference of arrival, signal strength, dedicated wireless location, etc.) and one or more wireless communication modems **86** (e.g., a cellular network transceiver, a wireless data network transceiver, a Wi-Fi transceiver, a Bluetooth transceiver, a 315 MHz transceiver, a zig bee transceiver, a 60 GHz transceiver, etc.). The I/O module **104** further includes a telco interface **108** (e.g., to interface to a public switched telephone network), a wired local area network (LAN) **88** (e.g., optical, electrical), and a wired wide area network (WAN) **90** (e.g., optical, electrical). The I/O module **104** further includes one or more peripheral devices (e.g., peripheral devices **1**-P) and one or more universal serial bus (USB) devices (USB devices **1**-U). In other embodiments, the computing device **100-1** may include more

or less devices and modules than shown in this example embodiment.

(51) FIG. **4** is a schematic block diagram of an embodiment of the environment sensor module **14** of the computing device of FIG. **2**B that includes a sensor interface module **120** to output environment sensor information **150** based on information communicated with a set of sensors. The set of sensors includes a visual sensor **122** (e.g., to the camera, 3-D camera, 360° view camera, a camera array, an optical spectrometer, etc.) and an audio sensor **124** (e.g., a microphone, a microphone array). The set of sensors further includes a motion sensor **126** (e.g., a solid-state Gyro, a vibration detector, a laser motion detector) and a position sensor **128** (e.g., a Hall effect sensor, an image detector, a GPS receiver, a radar system).

(52) The set of sensors further includes a scanning sensor **130** (e.g., CAT scan, MRI, x-ray, ultrasound, radio scatter, particle detector, laser measure, further radar) and a temperature sensor **132** (e.g., thermometer, thermal coupler). The set of sensors further includes a humidity sensor **134** (resistance based, capacitance based) and an altitude sensor **136** (e.g., pressure based, GPS-based, laser-based).

(53) The set of sensors further includes a biosensor **138** (e.g., enzyme, microbial) and a chemical sensor **140** (e.g., mass spectrometer, gas, polymer). The set of sensors further includes a magnetic sensor **142** (e.g., Hall effect, piezo electric, coil, magnetic tunnel junction) and any generic sensor **144** (e.g., including a hybrid combination of two or more of the other sensors).

(54) FIGS. **5**A-**5**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects. The mechanical and computing system includes a head unit system that includes the head unit **10-1** of FIG. **1**, the object **12-1** of FIG. **1**, the environment sensor module **14** of FIG. **2**B, and the computing entity **20-1** of FIG. **1**.

(55) The head unit system further includes an environment sensor (e.g., environment sensor module **14** of FIG. **2**B). The environment sensor is associated with an external environment that is external (e.g., outdoors) to an internal environment associated with the object. For example, the internal environment includes facilities inside a building and the external environment includes the environment outside the building.

(56) The head unit **10-1** includes a shear thickening fluid (STF) **42**. The STF is configured to have a decreasing viscosity in response to a first range of shear rates and an increasing viscosity in response to a second range of shear rates as discussed with reference to FIG. **1**B. The second range of shear rates are greater than the first range of shear rates.

(57) The head unit further includes a chamber **16**. The chamber is configured to contain a portion of the STF and includes a front channel **26** and a back channel **24**.

(58) The head unit further includes a piston **36** housed at least partially radially within the chamber **16** and separating the back channel **24** and the front channel **26**. The piston is configured to exert pressure against the shear thickening fluid in response to movement of the piston from a force applied to the piston from the object **12-1**. The movement of the piston includes one of traveling through the chamber in an inward direction or traveling through the chamber in an outward direction. The piston travels toward the back channel and away from the front channel when traveling in the inward direction. The piston travels toward the front channel and away from the back channel when traveling in the outward direction.

(59) The piston **36** includes a first piston bypass **38-1** between opposite sides of the piston that controls flow of the STF **42** between the opposite sides of the piston from the back channel to the front channel when the piston is traveling through the chamber in the inward direction to cause the STF to react with a first shear threshold effect.

(60) The piston **36** further includes a second piston bypass **38-2** between the opposite sides of the piston that controls flow of the STF between the opposite sides of the piston from the front channel to the back channel when the piston is traveling through the chamber in the outward direction to cause the STF to react with a second shear threshold effect.

(61) The head unit **10-1** further includes a set of fluid flow sensors **116-1-1** and **116-1-2** positioned proximal to the chamber **16**. The set of fluid flow sensors provide the fluid response **232-1-1** and **232-1-2** respectively from the STF **42**.
(62) The head unit **10-1** further includes set of fluid manipulation emitters **114-1-1** and **114-1-2** positioned proximal to the chamber **16**. The set of fluid manipulation emitters provide a fluid activation to at least one of the STF **42** (e.g., shifting the shear rate versus viscosity curve), the first piston bypass **38-1** (e.g., to block or allow flow of the STF), and the second piston bypass **38-2** to control the motion of the object **12-1**.
(63) FIG. **5**A illustrates an example of operation of a method for the controlling the operational aspects that includes the piston **36** moving inward towards the head unit **10-1** when the object **12-1** exerts the force on the plunger **28** that transfers the force to the piston **36**. As a result, the piston **36** exerts the force on the STF **42** within the back channel **24**.
(64) A first step of the example of operation includes the computing entity **20-1** interpreting a fluid response from the set of fluid flow sensors to produce a piston velocity **182** and a piston position **184** of the piston **36** associated with the head unit device of the head unit system. The set of fluid flow sensors are positioned proximal to the head unit device for controlling motion of the object **12-1** within the internal environment. For example, the computing entity **20-1** interprets fluid responses **232-1-1** and **232-1-2** from the STF **42** in response to varying responsiveness of particles of the STF to produce the piston velocity and the piston position.
(65) The interpreting the fluid response from the set of fluid flow sensors to produce the piston velocity and the piston position of the piston includes a series of sub-steps. A first sub-step includes inputting, from one or more fluid flow sensors of the set of fluid flow sensors, a set of fluid flow signals over a time range. For example, the computing entity **20-1** receives fluid responses **232-1-1** and **232-1-2** over the time range, where the fluid responses include the fluid flow signals.
(66) A second sub-step includes determining the fluid flow response of the set of fluid flow sensors based on the set of fluid flow signals. For example, the computing entity **20-1** interprets the fluid flow signals to produce the fluid flow response.
(67) A third sub-step includes determining the piston velocity based on the fluid flow response of the set of fluid flow sensors over the time range. For example, the computing entity **20-1** calculates piston velocity based on changes in the fluid flow response over the time range.
(68) A fourth sub-step includes determining the piston position based on the piston velocity and a real-time reference. For example, the computing entity **20-1** calculates the piston position based on time in the piston velocity as the piston moves through the chamber.
(69) As yet another example of interpreting the fluid response **232-1-1** and **232-1-2**, the computing entity **20-1** compares the fluid response **232-1-1** and **232-1-2** to previous measurements of fluid flow versus piston velocity and piston position to produce the piston velocity **182** and piston position **184**. As a still further example of the interpreting the fluid response **232-1-1** and **232-1-2**, the computing entity **20-1** extracts the piston velocity **182** and the piston position **184** directly from the fluid response **232-1-1** and/or **232-1-2** when the sensors **116-1-1** and **116-1-2** generate the piston velocity and piston position directly.
(70) The first step of the example of operation further includes the computing entity **20-1** determining a shear force **186** based on the piston velocity **182** and the piston position **184**. The determining the shear force based on the piston velocity and the piston position includes one approach of a variety of approaches. A first approach includes extracting the shear force directly from the fluid flow response when one or more fluid flow sensors of the set of fluid flow sensors outputs a shear force encoded signal. For example, the computing entity **20-1** extracts the shear force **186** directly from the fluid responses **232-1-1** and **232-1-2**. In an instance, the shear force **186** reveals the piston velocity versus force applied to the piston curve as illustrated in FIG. **5**A, where at a current time of interpreting the fluid flow response, the force and piston velocity are at a point Y**1**.

(71) A second approach includes determining the shear force utilizing the piston velocity and stored data for piston velocity versus shear force for the STF. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42**.
(72) A third approach includes determining the shear force utilizing the piston position and stored data for piston position and a piston bypass versus shear force for the STF within the chamber. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42** based on an actual valve opening status of the first piston bypass **38-1** (e.g., which allows flow of the STF from the back channel **24** to the front channel **26** when the piston is moving in the inward direction of the example).
(73) Having determined the piston velocity and the piston position, a second step of the example of operation includes the computing entity **20-1** interpreting an output of the environment sensor to identify an external factor of concern associated with the external environment that is likely to affect the internal environment. The external factor **149** of concern is associated with one or more of a wind gust, wind from a particular direction, rain, snow, humidity, air pressure, temperature, an air pollutant, and/or any other factor of concern. The interpreting the output of the environment sensor to identify the external factor of concern associated with the external environment that is likely to affect the internal environment includes a series of sub-steps.
(74) A first sub-step includes the computing entity **20-1** obtaining environment sensor information **150** from the environment sensor **14** for a set of timeframes (e.g., every second for 5 minutes). A second sub-step includes the computing entity **20-1** identifying an external factor of external factors **149** from the environment sensor information **150** for the set of timeframes. For example, periodic wind directions and/or periodic external temperatures.
(75) A third sub-step includes the computing entity **20-1** determining whether an amplitude of the external factor for the set of timeframes is greater than a maximum amplitude threshold level. For example, the computing entity **20-1** interprets environment sensor information **150** to identify external wind direction from the northwest with a wind speed of 75 miles an hour and determining that the wind speed is greater than a maximum wind speed threshold level (e.g., 40 mph).
(76) A fourth sub-step includes the computing entity **20-1** indicating the external factor of concern associated with the external environment that is likely to affect the internal environment when the amplitude of the external factor for the set of timeframes is greater than the maximum amplitude threshold level. For example, the computing entity **20-1** indicates a low external temperature as external factor of concern when interpreting the environment sensor information **150** to identify an external temperature of 20° below zero Fahrenheit and then determining that the external temperature is less than a minimum external temperature threshold level (e.g., 10° above zero Fahrenheit). The
(77) FIG. **5**B further illustrates the example of operation, where having detected the external factor of concern, in a third step the computing entity **20-1** determines the fluid activation **187** for the head unit based on the external factor of concern and one or more of the piston velocity, the piston position, and the shear force **186**. The determining the fluid activation for the head unit device based on the external factor of concern and one or more of the piston velocity and the piston position includes one or more of a variety of approaches.
(78) A first approach includes the computing entity **20-1** interpreting a request associated with modifying one or more of object velocity and object position. For example, the computing entity **20-1** receives the request from another computing entity with superior information with regards to the external environment and effects on the internal environment.
(79) A second approach includes the computing entity **20-1** interpreting guidance from a chamber database based on the external factor of concern. For example, the computing entity **20-1** accesses the chamber database **34** FIG. **1**A to recover the guidance for high winds and low temperatures

with regards to controlling internal environment objects (e.g., doors).
(80) A third approach includes the computing entity **20-1** establishing the fluid activation to include facilitating the second range of shear rates to slow down the object when detecting that the external factor of concern includes an external factor that indicates an abatement of the effect on the internal environment from the external factor of concern includes slowing down the object. For example, the computing entity **20-1** establishes the fluid activation **187** to facilitate closing of an external door more slowly when the external factor indicates an abundance of desirable fresh air.
(81) A fourth approach includes the computing entity **20-1** establishing the fluid activation to include facilitating the first range of shear rates to speed up the object when detecting that the external factor of concern includes another external factor that indicates the abatement of the effect on the internal environment from the external factor of concern includes speeding up the object. For example, the computing entity **20-1** establishes the fluid activation **187** to facilitate closing of an external door more quickly, yet safely, when the external factor is the wind speed and direction and the object **12-1** includes the external door. As another example, the computing entity **20-1** establishes the fluid activation **187** to facilitate closing of the external door more quickly, yet safely, when external factor is low ambient temperature.
(82) The third step further includes the computing entity **20-1** interpreting the output of the environment sensor to update the external factor of concern associated with the external environment to produce updated external factor of concern associated with the external environment. For example, the computing entity **20-1** reestablishes the external factor of concern 30 minutes later. Having updated the external factor of concern, the computing entity **20-1** updates the fluid activation for the head unit device based on the updated external factor of concern associated with the external environment and one or more of the piston velocity and the piston position. For example, the computing entity **20-1** reestablishes the fluid activation to adapt to the most recent external factor of concern.
(83) Having determined the fluid activation, a fourth step of the example method of operation includes the computing entity **20-1** activating the set of fluid manipulation emitters in accordance with the fluid activation to control the motion of the object to abate the effect on the internal environment from the external factor of concern. The control of the motion includes one or more of direct manipulation of the STF, facilitation of the first shear threshold effect associated with the first piston bypass, and facilitation of the second shear threshold effect associated with the second piston bypass.
(84) The activating the set of fluid manipulation emitters in accordance with the fluid activation to control the motion of the object to abate the effect on the internal environment from the external factor of concern includes a variety of approaches. When the piston is traveling through the chamber in the inward direction and when the STF is to have the decreasing viscosity, a first sub-approach includes the computing entity **20-1** issuing the fluid activation **234-1-1** to the set of fluid manipulation emitters **114-1-1** to cause one of the first piston bypass **38-1** to facilitate the first shear threshold effect to include the first range of shear rates, and the direct manipulation of the STF **42** to facilitate the first range of shear rates (e.g., lowering viscosity to speed up opening or closing of the door, raising viscosity to slow down the opening or the closing of the door).
(85) When the piston is traveling through the chamber in the inward direction and when the STF is to have the increasing viscosity, a second sub-approach includes the computing entity **20-1** issuing the fluid activation **234-1-2** to the set of fluid manipulation emitters **114-1-2** to cause one of the first piston bypass **38-1** to facilitate the first shear threshold effect to include the second range of shear rates, and the direct manipulation of the STF **42** to facilitate the second range of shear rates. For example, when the object **12-1** includes the external door closing (e.g., piston moving in the inward direction) in a high wind situation, the computing entity **20-1** outputs the fluid activation **234-1-1** to the piston bypass **38-1** to facilitate closing down the one-way check valve to prevent STF from moving from the back channel **24** to the front channel **26** thusly selecting the second

range of shear rates and a higher viscosity the STF to slow down the door to close safely moving from the point Y**1** to the point Y**2** (e.g., at a dead stop when closed) as illustrated in FIG. **5**B.

(86) When the piston is traveling through the chamber in the outward direction and when the STF is to have the decreasing viscosity a third sub-approach includes the computing entity **20-1** issuing the fluid activation **234-1-1** to the set of fluid manipulation emitters **114-1-1** to cause one of the second piston bypass **38-2** to facilitate the second shear threshold effect to include the first range of shear rates, and the direct manipulation of the STF **42** to facilitate the first range of shear rates.

(87) When the piston is traveling through the chamber in the outward direction and when the STF is to have the increasing viscosity a fourth sub-approach includes the computing entity **20-1** issuing the fluid activation **234-1-2** to the set of fluid manipulation emitters **114-1-2** to cause one of the second piston bypass **38-2** to facilitate the second shear threshold effect to include the second range of shear rates, and the direct manipulation of the STF **42** to facilitate the second range of shear rates.

(88) The method described above in conjunction with a processing module of any computing entity of the mechanical and computing system of FIG. **1** can alternatively be performed by other modules of the system of FIG. **1** or by other devices. In addition, at least one memory section that is non-transitory (e.g., a non-transitory computer readable storage medium, a non-transitory computer readable memory organized into a first memory element, a second memory element, a third memory element, a fourth element section, a fifth memory element, a sixth memory element, etc.) that stores operational instructions can, when executed by one or more processing modules of the one or more computing entities of the computing system **10**, cause one or more computing devices of the mechanical and computing system of FIG. **1** to perform any or all of the method steps described above.

(89) FIGS. **6**A-**6**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects. The mechanical and computing system includes the head unit **10-1** of FIG. **1**, the object **12-1** of FIG. **1**, and the computing entity **20-1** of FIG. **1**.

(90) The head unit system includes an environment sensor (e.g., environment sensor module **14** of FIG. **2**B). The environment sensor is associated with an internal environment that is internal to an external environment associated with the object. For example, the internal environment includes facilities inside a building and the external environment includes the environment outside the building.

(91) The head unit **10-1** includes a shear thickening fluid (STF) **42**. The STF is configured to have a decreasing viscosity in response to a first range of shear rates and an increasing viscosity in response to a second range of shear rates as discussed with reference to FIG. **1**B. The second range of shear rates are greater than the first range of shear rates.

(92) The head unit further includes a chamber **16**. The chamber is configured to contain a portion of the STF and includes a front channel **26** and a back channel **24**.

(93) The head unit further includes a piston **36** housed at least partially radially within the chamber **16** and separating the back channel **24** and the front channel **26**. The piston is configured to exert pressure against the shear thickening fluid in response to movement of the piston from a force applied to the piston from the object **12-1**. The movement of the piston includes one of traveling through the chamber in an inward direction or traveling through the chamber in an outward direction. The piston travels toward the back channel and away from the front channel when traveling in the inward direction. The piston travels toward the front channel and away from the back channel when traveling in the outward direction.

(94) The piston **36** includes a first piston bypass **38-1** between opposite sides of the piston that controls flow of the STF **42** between the opposite sides of the piston from the back channel to the front channel when the piston is traveling through the chamber in the inward direction to cause the STF to react with a first shear threshold effect.

(95) The piston **36** further includes a second piston bypass **38-2** between the opposite sides of the piston that controls flow of the STF between the opposite sides of the piston from the front channel to the back channel when the piston is traveling through the chamber in the outward direction to cause the STF to react with a second shear threshold effect.
(96) The head unit **10-1** further includes a set of fluid flow sensors **116-1-1** and **116-1-2** positioned proximal to the chamber **16**. The set of fluid flow sensors provide the fluid response **232-1-1** and **232-1-2** respectively from the STF **42**.
(97) The head unit **10-1** further includes set of fluid manipulation emitters **114-1-1** and **114-1-2** positioned proximal to the chamber **16**. The set of fluid manipulation emitters provide a fluid activation to at least one of the STF **42** (e.g., shifting the shear rate versus viscosity curve), the first piston bypass **38-1** (e.g., to block or allow flow of the STF), and the second piston bypass **38-2** to control the motion of the object **12-1**.
(98) FIG. **6**A illustrates an example of operation of a method for the controlling the operational aspects. A first step of the example of operation includes the piston **36** moving inward towards the head unit **10-1** when the object **12-1** exerts the force on the plunger **28** that transfers the force to the piston **36**. As a result, the piston **36** exerts the force on the STF **42** within the back channel **24**.
(99) A second step of the example of operation includes the computing entity **20-1** interpreting a fluid response from the set of fluid flow sensors to produce a piston velocity **182** and a piston position **184** of the piston **36** associated with a head unit device of a head unit system. The set of fluid flow sensors are positioned proximal to the head unit device for controlling motion of the object **12-1** within the internal environment. For example, the computing entity **20-1** interprets fluid responses **232-1-1** and **232-1-2** from the STF **42** in response to varying responsiveness of particles of the STF to produce the piston velocity and the piston position.
(100) The interpreting the fluid response from the set of fluid flow sensors to produce the piston velocity and the piston position of the piston includes a series of sub-steps. A first sub-step includes inputting, from one or more fluid flow sensors of the set of fluid flow sensors, a set of fluid flow signals over a time range. For example, the computing entity **20-1** receives fluid responses **232-1-1** and **232-1-2** over the time range, where the fluid responses include the fluid flow signals.
(101) A second sub-step includes determining the fluid flow response of the set of fluid flow sensors based on the set of fluid flow signals. For example, the computing entity **20-1** interprets the fluid flow signals to produce the fluid flow response.
(102) A third sub-step includes determining the piston velocity based on the fluid flow response of the set of fluid flow sensors over the time range. For example, the computing entity **20-1** calculates piston velocity based on changes in the fluid flow response over the time range.
(103) A fourth sub-step includes determining the piston position based on the piston velocity and a real-time reference. For example, the computing entity **20-1** calculates the piston position based on time in the piston velocity as the piston moves through the chamber.
(104) As yet another example of interpreting the fluid response **232-1-1** and **232-1-2**, the computing entity **20-1** compares the fluid response **232-1-1** and **232-1-2** to previous measurements of fluid flow versus piston velocity and piston position to produce the piston velocity **182** and piston position **184**. As a still further example of the interpreting the fluid response **232-1-1** and **232-1-2**, the computing entity **20-1** extracts the piston velocity **182** and the piston position **184** directly from the fluid response **232-1-1** and/or **232-1-2** when the sensors **116-1-1** and **116-1-2** generate the piston velocity and piston position directly.
(105) The second step of the example of operation further includes the computing entity **20-1** determining a shear force **186** based on the piston velocity **182** and the piston position **184**. The determining the shear force based on the piston velocity and the piston position includes one approach of a variety of approaches. A first approach includes extracting the shear force directly from the fluid flow response when one or more fluid flow sensors of the set of fluid flow sensors outputs a shear force encoded signal. For example, the computing entity **20-1** extracts the shear

force **186** directly from the fluid responses **232-1-1** and **232-1-2**. In an instance, the shear force **186** reveals the piston velocity versus force applied to the piston curve as illustrated in FIG. **6**A, where at a current time of interpreting the fluid flow response, the force and piston velocity are at a point Y**1**.
(106) A second approach includes determining the shear force utilizing the piston velocity and stored data for piston velocity versus shear force for the STF. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42**.
(107) A third approach includes determining the shear force utilizing the piston position and stored data for piston position and a piston bypass versus shear force for the STF within the chamber. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42** based on an actual valve opening status of the first piston bypass **38-1** (e.g., which allows flow of the STF from the back channel **24** to the front channel **26** when the piston is moving in the inward direction of the example).
(108) A third step of the example of operation includes the computing entity **20-1** interpreting an output of the environment sensor to identify an internal factor **151** of concern associated with the internal environment. The internal factor **151** of concern is associated with one or more of internal air quality, an internal smoke level, date, time of day, a building activity schedule, internal humidity, internal air pressure, internal temperature, fire alarm status, intrusion alarm status, building lockdown status, a building occupancy level, a maximum building occupancy threshold level, building power status, a solar array status, a heating-ventilation-and-cooling (HVAC) status, and/or any other factor of concern. For example, the computing entity **20-1** interprets environment sensor information **150** to identify smoke in a storage room. As another example, the computing entity **20-1** interprets the environment sensor information **150** to identify a scheduled lunch time building activity (e.g., where more than average number of people are moving about within the building).
(109) FIG. **6**B further illustrates the example of operation, where having detected the internal factor of concern, in a fourth step the computing entity **20-1** determines the fluid activation **187** for the head unit based on the internal factor of concern and one or more of the piston velocity, the piston position, and the shear force **186**. For example, the computing entity **20-1** establishes the fluid activation **187** to facilitate closing of an internal door associated with the storage room more quickly when the internal factor is the smoke detected in the storage room and the object **12-1** includes the internal door to the storage room. As another example, the computing entity **20-1** establishes the fluid activation **187** to facilitate closing of the external door slower than average, and safely, when the scheduled lunch time building activity is detected as the internal factor of concern.
(110) In particular, the computing entity **20-1** determines the fluid activation **187** to adjust the viscosity of the STF to facilitate movement of the piston and hence door in a more desirable fashion based on the identified internal factor of concern. The determining the fluid activation **187** includes a variety of approaches. A first approach includes opening of either of the piston bypass **38-1** and piston bypass **38-2** allow the STF to move between the back channel **24** and the front channel **26** to lower the shear rate and thus select a lower viscosity which in turn allows more rapid movement of the piston in the chamber and hence speeds up the door. A second approach includes opening of the chamber bypass **42** to lower the viscosity the STF. A third approach includes activating the set of emitters to directly alter the viscosity of the STF in a desired fashion (e.g., lowering viscosity to speed up opening or closing of the door, raising viscosity to slow down the opening or the closing of the door).
(111) A fifth step of the example method of operation includes the computing entity **20-1** activating the set of fluid manipulation emitters **114-1-1** and **114-1-2** in accordance with the fluid activation

187 to manipulate one of the first shear threshold effect associated with the first piston bypass **38-1** and the second shear threshold effect associated with the second piston bypass **38-2** to control the motion of the object **12-1** to abate the effect on the internal environment from the internal factor of concern. For example, when the object **12-1** includes the internal door to the storage room and is closing when moving in the inward direction, the computing entity **20-1** outputs the fluid activation **234-1-1** to the piston bypass **38-1** to facilitate further opening of a one-way check valve to allow more of the STF to move from the back channel **24** to the front channel **26** thusly selecting the first range of shear rates and a lower viscosity of the STF to speed up the door to close when the internal factor of concern is the detected smoke in the storage room.

(112) As another example, when the object **12-1** includes the external door closing (e.g., piston moving in the inward direction) in a high-traffic lunchtime situation, the computing entity **20-1** outputs the fluid activation **234-1-1** to the piston bypass **38-1** to facilitate closing down the one-way check valve to prevent STF from moving from the back channel **24** to the front channel **26** thusly selecting the second range of shear rates and a higher viscosity the STF to slow down the door to close safely moving from the point Y**1** to the point Y**2** (e.g., at a dead stop when closed and no one is coming through the door) as illustrated in FIG. **6**B.

(113) In yet another embodiment, the computing entity **20-1** detects both an external factor of concern and the internal factor of concern to produce the fluid activation **187**. For example, even when the external temperature is very low, the computing entity **20-1** controls the head unit system to close the door slowly when a higher than normal traffic pattern of people going through that door is detected.

(114) The method described above in conjunction with a processing module of any computing entity of the mechanical and computing system of FIG. **1** can alternatively be performed by other modules of the system of FIG. **1** or by other devices. In addition, at least one memory section that is non-transitory (e.g., a non-transitory computer readable storage medium, a non-transitory computer readable memory organized into a first memory element, a second memory element, a third memory element, a fourth element section, a fifth memory element, a sixth memory element, etc.) that stores operational instructions can, when executed by one or more processing modules of the one or more computing entities of the computing system **10**, cause one or more computing devices of the mechanical and computing system of FIG. **1** to perform any or all of the method steps described above.

(115) FIGS. **7**A-**7**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects. The mechanical and computing system includes the head unit **10-1** of FIG. **1**, the object **12-1** of FIG. **1** (e.g., a door), a secondary object **12-2** (e.g., a person), and the computing entity **20-1** of FIG. **1**.

(116) The head unit system includes a secondary object sensor (e.g., environment sensor module **14** of FIG. **2**B). The secondary object is associated with the object (e.g., the person goes through the door).

(117) The head unit **10-1** includes a shear thickening fluid (STF) **42**. The STF is configured to have a decreasing viscosity in response to a first range of shear rates and an increasing viscosity in response to a second range of shear rates as discussed with reference to FIG. **1**B. The second range of shear rates are greater than the first range of shear rates.

(118) The head unit further includes a chamber **16**. The chamber is configured to contain a portion of the STF and includes a front channel **26** and a back channel **24**.

(119) The head unit further includes a piston **36** housed at least partially radially within the chamber **16** and separating the back channel **24** and the front channel **26**. The piston is configured to exert pressure against the shear thickening fluid in response to movement of the piston from a force applied to the piston from the object **12-1**. The movement of the piston includes one of traveling through the chamber in an inward direction or traveling through the chamber in an outward direction. The piston travels toward the back channel and away from the front channel

when traveling in the inward direction. The piston travels toward the front channel and away from the back channel when traveling in the outward direction.

(120) The piston **36** includes a first piston bypass **38-1** between opposite sides of the piston that controls flow of the STF **42** between the opposite sides of the piston from the back channel to the front channel when the piston is traveling through the chamber in the inward direction to cause the STF to react with a first shear threshold effect.

(121) The piston **36** further includes a second piston bypass **38-2** between the opposite sides of the piston that controls flow of the STF between the opposite sides of the piston from the front channel to the back channel when the piston is traveling through the chamber in the outward direction to cause the STF to react with a second shear threshold effect.

(122) The head unit **10-1** further includes a set of fluid flow sensors **116-1-1** and **116-1-2** positioned proximal to the chamber **16**. The set of fluid flow sensors provide the fluid response **232-1-1** and **232-1-2** respectively from the STF **42**.

(123) The head unit **10-1** further includes set of fluid manipulation emitters **114-1-1** and **114-1-2** positioned proximal to the chamber **16**. The set of fluid manipulation emitters provide a fluid activation to at least one of the STF **42** (e.g., shifting the shear rate versus viscosity curve), the first piston bypass **38-1** (e.g., to block or allow flow of the STF), and the second piston bypass **38-2** to control the motion of the object **12-1** with regards to the secondary object (e.g., avoiding a collision between the door and the person).

(124) FIG. **7**A illustrates an example of operation of a method for the controlling the operational aspects. A first step of the example of operation includes the piston **36** moving outward away from the head unit **10-1** when the object **12-1** exerts a pulling force on the plunger **28** that transfers the force to the piston **36**. As a result, the piston **36** exerts the force on the STF **42** within the front channel **26**.

(125) A second step of the example of operation includes the computing entity **20-1** interpreting a fluid response from the set of fluid flow sensors to produce a piston velocity **182** and a piston position **184** of the piston **36** associated with a head unit device of a head unit system. The set of fluid flow sensors are positioned proximal to the head unit device for controlling motion of the object **12-1** within the internal environment. For example, the computing entity **20-1** interprets fluid responses **232-1-1** and **232-1-2** from the STF **42** in response to varying responsiveness of particles of the STF to produce the piston velocity and the piston position.

(126) The interpreting the fluid response from the set of fluid flow sensors to produce the piston velocity and the piston position of the piston includes a series of sub-steps. A first sub-step includes inputting, from one or more fluid flow sensors of the set of fluid flow sensors, a set of fluid flow signals over a time range. For example, the computing entity **20-1** receives fluid responses **232-1-1** and **232-1-2** over the time range, where the fluid responses include the fluid flow signals.

(127) A second sub-step includes determining the fluid flow response of the set of fluid flow sensors based on the set of fluid flow signals. For example, the computing entity **20-1** interprets the fluid flow signals to produce the fluid response.

(128) A third sub-step includes determining the piston velocity based on the fluid response of the set of fluid flow sensors over the time range. For example, the computing entity **20-1** calculates piston velocity based on changes in the fluid response over the time range.

(129) A fourth sub-step includes determining the piston position based on the piston velocity and a real-time reference. For example, the computing entity **20-1** calculates the piston position based on time in the piston velocity as the piston moves through the chamber.

(130) As yet another example of interpreting the fluid response **232-1-1** and **232-1-2**, the computing entity **20-1** compares the fluid response **232-1-1** and **232-1-2** to previous measurements of fluid flow versus piston velocity and piston position to produce the piston velocity **182** and piston position **184**. As a still further example of the interpreting the fluid response **232-1-1** and **232-1-2**, the computing entity **20-1** extracts the piston velocity **182** and the piston position **184**

directly from the fluid response **232-1-1** and/or **232-1-2** when the sensors **116-1-1** and **116-1-2** generate the piston velocity and piston position directly.
(131) The second step of the example of operation further includes the computing entity **20-1** determining a shear force **186** based on the piston velocity **182** and the piston position **184**. The determining the shear force based on the piston velocity and the piston position includes one approach of a variety of approaches. A first approach includes extracting the shear force directly from the fluid response when one or more fluid flow sensors of the set of fluid flow sensors outputs a shear force encoded signal. For example, the computing entity **20-1** extracts the shear force **186** directly from the fluid responses **232-1-1** and **232-1-2**. In an instance, the shear force **186** reveals the piston velocity versus force applied to the piston curve as illustrated in FIG. **7**A, where at a current time of interpreting the fluid flow response, the force and piston velocity are at a point Y**3** (e.g., a negative velocity since moving in the outward direction).
(132) A second approach includes determining the shear force utilizing the piston velocity and stored data for piston velocity versus shear force for the STF. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42**.
(133) A third approach includes determining the shear force utilizing the piston position and stored data for piston position and a piston bypass versus shear force for the STF within the chamber. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42** based on an actual valve opening status of the first piston bypass **38-1** (e.g., which allows flow of the STF from the front channel **26** to the back channel **24** when the piston is moving in the outward direction of the example).
(134) A third step of the example of operation includes the computing entity **20-1** interpreting an output of the secondary object sensor to produce an object type of the secondary object. The object type includes a person, a child, an elderly person, a group of people, a patient transport gurney, a cart, a short cart, a long cart, a cart train, a motor scooter, a vehicle, a jack truck, a pallet hauler, a 2 wheel hauler, a set of animals, and/or type of anything that can move through a door. The interpreting includes interpreting environment sensor information **150** from the secondary object sensor (e.g., from the environment sensor module **14**), comparing the environment sensor information **150** to previously stored information for each of the object types, and selecting the object type when a match is detected. For example, the computing entity **20-1** compares an image of the environment sensor information **152** a stored image of a cart and identifies the secondary object as the cart when matching the image of the environment sensor information **150** to the stored image.
(135) FIG. **7**B further illustrates the example of operation, where having determined the object type, in a fourth step the computing entity **20-1** determines the fluid activation **187** for the head unit based on the object type and one or more of the piston velocity, the piston position, and the shear force **186**. For example, the computing entity **20-1** establishes the fluid activation **187** to facilitate closing of an external door more quickly, yet safely, when the object type is a short cart. As another example, the computing entity **20-1** establishes the fluid activation **187** to facilitate closing of the external door more slowly when the object type is an elderly person.
(136) In particular, the computing entity **20-1** determines the fluid activation **187** to adjust the viscosity of the STF to facilitate movement of the piston and hence door in a more desirable fashion based on the identified object type. The determining the fluid activation **187** includes a variety of approaches. A first approach includes opening of either of the piston bypass **38-1** and piston bypass **38-2** allow the STF to move between the back channel **24** and the front channel **26** to lower the shear rate and thus select a lower viscosity which in turn allows more rapid movement of the piston in the chamber and hence speeds up the door. A second approach includes opening of the chamber bypass **42** to lower the viscosity the STF. A third approach includes activating the set of

emitters to directly alter the viscosity of the STF in a desired fashion (e.g., lowering viscosity to speed up opening or closing of the door, raising viscosity to slow down the opening or the closing of the door).
(137) A fifth step of the example method of operation includes the computing entity **20-1** activating the set of fluid manipulation emitters **114-1-1** and **114-1-2** in accordance with the fluid activation **187** to manipulate one of the first shear threshold effect associated with the first piston bypass **38-1** and the second shear threshold effect associated with the second piston bypass **38-2** to control the motion of the object **12-1** to control the motion of the object with regards to the secondary object. For example, when the object **12-1** includes an operating room door and is opening when moving in the outward direction, the computing entity **20-1** outputs the fluid activation **234-1-1** to the piston bypass **38-2** to facilitate further opening of a one-way check valve to allow more of the STF to move from the front channel **26** to the back channel **24** thusly selecting the first range of shear rates and a lower viscosity of the STF to speed up the door to open when the detected secondary object is a patient transport gurney entering the operating room.
(138) As another example, when the object **12-2** includes the group of people, the computing entity **20-1** outputs the fluid activation **234-1-1** to the piston bypass **38-1** to facilitate closing down the one-way check valve to prevent STF from moving from the back channel **24** to the front channel **26** thusly selecting the second range of shear rates and a higher viscosity the STF to slow down the door to close safely moving from the point Y**3** to the point Y**4** (e.g., when the piston is moving in the outward direction) as illustrated in FIG. **7**B.
(139) The method described above in conjunction with a processing module of any computing entity of the mechanical and computing system of FIG. **1** can alternatively be performed by other modules of the system of FIG. **1** or by other devices. In addition, at least one memory section that is non-transitory (e.g., a non-transitory computer readable storage medium, a non-transitory computer readable memory organized into a first memory element, a second memory element, a third memory element, a fourth element section, a fifth memory element, a sixth memory element, etc.) that stores operational instructions can, when executed by one or more processing modules of the one or more computing entities of the computing system **10**, cause one or more computing devices of the mechanical and computing system of FIG. **1** to perform any or all of the method steps described above.
(140) FIGS. **8**A-**8**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects. The mechanical and computing system provides a head unit system that includes the head unit **10-1** of FIG. **1**, the object **12-1** of FIG. **1** (e.g., a door), a plurality of secondary objects **12-2** through **12-**N, a secondary object sensor (e.g., the environment sensor module **14** of FIG. **2**B to detect the secondary objects), and the computing entity **20-1** of FIG. **1**. The secondary object sensor is associated with the object **12-1** and the secondary objects are associated with the object.
(141) The head unit system includes the secondary object sensor. The plurality of secondary objects is associated with the object (e.g., a group of people go through the door).
(142) The head unit **10-1** includes a shear thickening fluid (STF) **42**. The STF is configured to have a decreasing viscosity in response to a first range of shear rates and an increasing viscosity in response to a second range of shear rates as discussed with reference to FIG. **1**B. The second range of shear rates are greater than the first range of shear rates.
(143) The head unit further includes a chamber **16**. The chamber is configured to contain a portion of the STF and includes a front channel **26** and a back channel **24**.
(144) The head unit further includes a piston **36** housed at least partially radially within the chamber **16** and separating the back channel **24** and the front channel **26**. The piston is configured to exert pressure against the shear thickening fluid in response to movement of the piston from a force applied to the piston from the object **12-1**. The movement of the piston includes one of traveling through the chamber in an inward direction or traveling through the chamber in an

outward direction. The piston travels toward the back channel and away from the front channel when traveling in the inward direction. The piston travels toward the front channel and away from the back channel when traveling in the outward direction.
(145) The piston **36** includes a first piston bypass **38-1** between opposite sides of the piston that controls flow of the STF **42** between the opposite sides of the piston from the back channel to the front channel when the piston is traveling through the chamber in the inward direction to cause the STF to react with a first shear threshold effect.
(146) The piston **36** further includes a second piston bypass **38-2** between the opposite sides of the piston that controls flow of the STF between the opposite sides of the piston from the front channel to the back channel when the piston is traveling through the chamber in the outward direction to cause the STF to react with a second shear threshold effect.
(147) The head unit **10-1** further includes a set of fluid flow sensors **116-1-1** and **116-1-2** positioned proximal to the chamber **16**. The set of fluid flow sensors provide the fluid response **232-1-1** and **232-1-2** respectively from the STF **42**.
(148) The head unit **10-1** further includes set of fluid manipulation emitters **114-1-1** and **114-1-2** positioned proximal to the chamber **16**. The set of fluid manipulation emitters provide a fluid activation to at least one of the STF **42** (e.g., shifting the shear rate versus viscosity curve), the first piston bypass **38-1** (e.g., to block or allow flow of the STF), and the second piston bypass **38-2** to control the motion of the object **12-1** with regards to the set of secondary objects (e.g., avoiding a collision between the door and the group people).
(149) FIG. **8**A illustrates an example of operation of a method for the controlling the operational aspects. In the example of operation, the piston **36** moves outward away from the head unit **10-1** when the object **12-1** exerts a pulling force on the plunger **28** that transfers the force to the piston **36**. As a result, the piston **36** exerts the force on the STF **42** within the front channel **26**.
(150) A first step of the example of operation includes the computing entity **20-1** interpreting a fluid response from the set of fluid flow sensors to produce a piston velocity **182** and a piston position **184** of the piston **36** associated with a head unit device of a head unit system. The set of fluid flow sensors are positioned proximal to the head unit device for controlling motion of the object **12-1**. For example, the computing entity **20-1** interprets fluid responses **232-1-1** and **232-1-2** from the STF **42** in response to varying responsiveness of particles of the STF to produce the piston velocity and the piston position.
(151) The interpreting the fluid response from the set of fluid flow sensors to produce the piston velocity and the piston position of the piston includes a series of sub-steps. A first sub-step includes inputting, from one or more fluid flow sensors of the set of fluid flow sensors, a set of fluid flow signals over a time range. For example, the computing entity **20-1** receives fluid responses **232-1-1** and **232-1-2** over the time range, where the fluid responses include the fluid flow signals.
(152) A second sub-step includes determining the fluid flow response of the set of fluid flow sensors based on the set of fluid flow signals. For example, the computing entity **20-1** interprets the fluid flow signals to produce the fluid response.
(153) A third sub-step includes determining the piston velocity based on the fluid response of the set of fluid flow sensors over the time range. For example, the computing entity **20-1** calculates piston velocity based on changes in the fluid response over the time range.
(154) A fourth sub-step includes determining the piston position based on the piston velocity and a real-time reference. For example, the computing entity **20-1** calculates the piston position based on time in the piston velocity as the piston moves through the chamber.
(155) As yet another example of interpreting the fluid response **232-1-1** and **232-1-2**, the computing entity **20-1** compares the fluid response **232-1-1** and **232-1-2** to previous measurements of fluid flow versus piston velocity and piston position to produce the piston velocity **182** and piston position **184**. As a still further example of the interpreting the fluid response **232-1-1** and **232-1-2**, the computing entity **20-1** extracts the piston velocity **182** and the piston position **184**

directly from the fluid response **232-1-1** and/or **232-1-2** when the sensors **116-1-1** and **116-1-2** generate the piston velocity and piston position directly.

(156) The first step of the example of operation further includes the computing entity **20-1** determining a shear force **186** based on the piston velocity **182** and the piston position **184**. The determining the shear force based on the piston velocity and the piston position includes one approach of a variety of approaches. A first approach includes extracting the shear force directly from the fluid response when one or more fluid flow sensors of the set of fluid flow sensors outputs a shear force encoded signal. For example, the computing entity **20-1** extracts the shear force **186** directly from the fluid responses **232-1-1** and **232-1-2**. In an instance, the shear force **186** reveals the piston velocity versus force applied to the piston curve as illustrated in FIG. **8**A, where at a current time of interpreting the fluid flow response, the force and piston velocity are at a point Y**3** (e.g., a negative velocity since moving in the outward direction).

(157) A second approach includes determining the shear force utilizing the piston velocity and stored data for piston velocity versus shear force for the STF. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42**.

(158) A third approach includes determining the shear force utilizing the piston position and stored data for piston position and a piston bypass versus shear force for the STF within the chamber. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42** based on an actual valve opening status of the second piston bypass **38-2** (e.g., which allows flow of the STF from the front channel **26** to the back channel **24** when the piston is moving in the outward direction of the example).

(159) A second step of the example of operation includes the computing entity **20-1** interpreting an output of the secondary object sensor to update an object pattern of the plurality of secondary objects. The object pattern includes the object type as previously discussed and activity parameters associated with objects of the object type. The activity parameters includes a person walking, a person running, a group of people walking, a group of people running, a set of secondary objects moving towards the object, the set of second area objects moving away from the object, and/or any other possible activity type associated with one or more of the secondary objects.

(160) The interpreting the output of the secondary object sensor to update the object pattern of the plurality of secondary objects to produce the updated object pattern of the plurality of secondary objects includes a series of sub-steps. A first sub-step includes the computing entity **20-1** obtaining environment sensor information **150** from the secondary object sensor (e.g., environment sensor module **14**) for a subset of secondary objects of the plurality of secondary objects (e.g., **12-2** through **12**-N).

(161) A second sub-step includes the computing entity **20-1** identifying activity parameters from the environment sensor information for the subset of secondary objects. For example, the computing entity **20-1** compares a video clip of the environment sensor information **150** to a stored video clip of a group of people walking towards a door and identifies the object pattern as a group of people walking when matching the video clip of the environment sensor information **150** to the stored video clip of the person walking. As another example, the computing entity **20-1** further determines walking velocities for the group of people from the video clip from the video clip.

(162) A third sub-step includes the computing entity **20-1** obtaining the object pattern of the plurality of secondary objects. For example, the computing entity **20-1** recovers the object pattern from a local memory of the computing entity **20-1**. As another example, the computing entity **20-1** extracts the object pattern from activity information **153** recovered from the chamber database **34**.

(163) A fourth sub-step includes the computing entity **20-1** modifying the object pattern of the plurality of secondary objects based on the activity parameters for the subset of secondary objects to produce the updated object pattern of the plurality of secondary objects. For example, the

computing entity **20-1** modifies the walking velocities for the group of people based on the recently extracted walking velocities for the group of people.

(164) FIG. **8**B further illustrates the example of operation, where having determined the updated object pattern for the plurality of secondary objects, a third step includes the computing entity **20-1** determining fluid activation **187** for the head unit based on the updated object pattern of the plurality of secondary objects and one or more of activity information **153**, the piston velocity **182**, the piston position **184**, and the shear force **186**. The activity information **153** includes historical records and schedules for future activities associated with the set of secondary objects. For example, the activity information **153** includes a work schedule, a class schedule, timeclock punching information indicating which employees are present at an area of employment, invoicing information associated with product flow, manufacturing process information, inventory control information, and/or any other information that assists in identifying the object pattern for the set of secondary objects.

(165) The determining the fluid activation for the head unit device is based on the updated object pattern of the plurality of secondary objects and one or more of the piston velocity and the piston position includes one or more sub-steps. A first sub-step includes the computing entity **20-1** interpreting a request associated with modifying one or more of object velocity and object position. For example, the computing entity **20-1** receives the request from another computing entity. A second sub-step includes the computing entity interpreting fluid activation guidance from the chamber database **34** based on the updated object pattern of the plurality of secondary objects. For example, the computing entity **20-1** accesses the chamber database **34** based on the updated object pattern to locate the fluid activation guidance.

(166) A third sub step includes the computing entity **20-1** interpreting activity information **153** from the chamber database **34** based on the updated object pattern of the plurality of secondary objects to produce an object movement recommendation. A correlation between the activity information and the updated object pattern of the plurality of secondary objects suggests an expected movement behavior of the secondary object. For example, analysis of one hundred plus instances of groups of people walking through doors is summarized in the chamber database as the activity information **153** such that one more instance of the group of people walking through a particular door is expected to be similar.

(167) A fourth sub-step includes the computing entity **20-1** determining a position for the secondary object based the updated object pattern of the plurality of secondary objects. For example, the computing entity **20-1** estimates a next position for a person walking through the door based on the pattern of the groups of people walking through the doors.

(168) A fifth sub-step includes the computing entity **20-1** determining an object position for the object based on the piston velocity and the piston position. For example, the computing entity **20-1** estimates the object position for the object (e.g., a door with regards to the secondary object, a person) based on historical data of piston velocity and piston position verses position of the object (e.g., the door).

(169) A sixth sub-step includes the computing entity **20-1** establishing the fluid activation to include facilitating the first range of shear rates when the object movement recommendation includes increasing velocity of the object. For example, when the piston is traveling in the outward direction to open the door, the first range of shear rates is selected when the object movement recommendation includes opening the door more quickly to avoid a collision between the person and the door.

(170) A seventh sub-step includes the computing entity **20-1** establishing the fluid activation to include facilitating the second range of shear rates when the object movement recommendation includes decreasing the velocity of the object. For example, when the piston is traveling in the outward direction to close the door, the second range of shear rates is selected when the object movement recommendation includes closing the door more slowly to avoid the collision between

the person and the door. As another example of the determining of the fluid activation **187**, the computing entity **20-1** establishes the fluid activation **187** to facilitate opening of a large door more quickly, yet safely, when the object pattern is the group of people approaching the door and the activity information **153** indicates that a current time frame is a lunch. When large groups of people are expected to be moving through the door. As a still further example, the computing entity **20-1** establishes the fluid activation **187** to facilitate closing of the large door more slowly when the object pattern is the group of people passing through the door.
(171) In particular, the computing entity **20-1** determines the fluid activation **187** to produce a mechanism to adjust the viscosity of the STF to facilitate movement of the piston and hence door in a more desirable fashion based on the identified object type. The mechanism to adjust the viscosity includes a variety of approaches. A first approach includes opening of either of the piston bypass **38-1** and piston bypass **38-2** allow the STF to move between the back channel **24** and the front channel **26** to lower the shear rate and thus select a lower viscosity which in turn allows more rapid movement of the piston in the chamber and hence speeds up the door. A second approach includes opening of the chamber bypass **42** to lower the viscosity the STF. A third approach includes activating the set of emitters to directly alter the viscosity of the STF in a desired fashion (e.g., lowering viscosity to speed up opening or closing of the door, raising viscosity to slow down the opening or the closing of the door).
(172) The determining the fluid activation further includes interpreting the output of the secondary object sensor to further update the object pattern of the plurality of secondary objects to produce a further updated object pattern of the plurality of secondary objects. For example, the computing entity **20-1** further analyzes environment sensor information **150** from the environment sensor module **14** to update the object pattern. Having produced the further updated object pattern, the computing entity **20-1** updates the fluid activation for the head unit device based on the further updated object pattern of the plurality of secondary objects and one or more of the piston velocity and the piston position as previously discussed.
(173) A fourth step of the example method of operation includes the computing entity **20-1** activating the set of fluid manipulation emitters **114-1-1** and **114-1-2** in accordance with the fluid activation **187** to manipulate one of the first shear threshold effect associated with the first piston bypass **38-1** and the second shear threshold effect associated with the second piston bypass **38-2** to control the motion of the object **12-1** to control the motion of the object with regards to the secondary object. For example, when the object **12-1** includes a large lunchroom door and is opening when moving in the outward direction, the computing entity **20-1** outputs the fluid activation **234-1-1** to the piston bypass **38-2** to facilitate further opening of a one-way check valve to allow more of the STF to move from the front channel **26** to the back channel **24** thusly selecting the first range of shear rates and a lower viscosity of the STF to speed up the door to open when the detected set of secondary objects is a group of people passing through the lunch room door during the lunch period.
(174) As another example, when the set of secondary objects **12-2** through **12**-N includes the group of people, the computing entity **20-1** outputs the fluid activation **234-1-1** to the piston bypass **38-2** to facilitate closing down the one-way check valve to prevent STF from moving from the front channel **26** to the back channel **24** thusly selecting the second range of shear rates and a higher viscosity the STF to slow down the door to close safely moving from the point Y**3** to the point Y**4** (e.g., when the piston is moving in the outward direction) as illustrated in FIG. **8**B.
(175) The activating the set of fluid manipulation emitters in accordance with the fluid activation to control the motion of the object includes a variety of approaches. When the piston is traveling through the chamber in the inward direction and when the STF is to have the decreasing viscosity, a first sub-approach includes the computing entity **20-1** issuing the fluid activation **234-1-1** to the set of fluid manipulation emitters **114-1-1** to cause one of the first piston bypass **38-1** to facilitate the first shear threshold effect to include the first range of shear rates, and the direct manipulation of

the STF **42** to facilitate the first range of shear rates (e.g., lowering viscosity to speed up opening or closing of the door, raising viscosity to slow down the opening or the closing of the door).

(176) When the piston is traveling through the chamber in the inward direction and when the STF is to have the increasing viscosity, a second sub-approach includes the computing entity **20-1** issuing the fluid activation **234-1-2** to the set of fluid manipulation emitters **114-1-2** to cause one of the first piston bypass **38-1** to facilitate the first shear threshold effect to include the second range of shear rates, and the direct manipulation of the STF **42** to facilitate the second range of shear rates.

(177) When the piston is traveling through the chamber in the outward direction and when the STF is to have the decreasing viscosity a third sub-approach includes the computing entity **20-1** issuing the fluid activation **234-1-1** to the set of fluid manipulation emitters **114-1-1** to cause one of the second piston bypass **38-2** to facilitate the second shear threshold effect to include the first range of shear rates, and the direct manipulation of the STF **42** to facilitate the first range of shear rates.

(178) When the piston is traveling through the chamber in the outward direction and when the STF is to have the increasing viscosity a fourth sub-approach includes the computing entity **20-1** issuing the fluid activation **234-1-2** to the set of fluid manipulation emitters **114-1-2** to cause one of the second piston bypass **38-2** to facilitate the second shear threshold effect to include the second range of shear rates, and the direct manipulation of the STF **42** to facilitate the second range of shear rates.

(179) The method described above in conjunction with a processing module of any computing entity of the mechanical and computing system of FIG. **1** can alternatively be performed by other modules of the system of FIG. **1** or by other devices. In addition, at least one memory section that is non-transitory (e.g., a non-transitory computer readable storage medium, a non-transitory computer readable memory organized into a first memory element, a second memory element, a third memory element, a fourth element section, a fifth memory element, a sixth memory element, etc.) that stores operational instructions can, when executed by one or more processing modules of the one or more computing entities of the computing system **10**, cause one or more computing devices of the mechanical and computing system of FIG. **1** to perform any or all of the method steps described above.

(180) FIGS. **9**A-**9**B are schematic block diagrams of another embodiment of a mechanical and computing system illustrating an example of controlling operational aspects. The mechanical and computing system provides a head unit system that includes the head unit **10-1** of FIG. **1**, the object **12-1** a FIG. **1** (e.g., a first door), a set of objects **12-2** through **12**-N (e.g., people of a first building passing through the first door), a secondary object sensor (e.g., the environment sensor module **14** of FIG. **2**B to detect the people), the chamber database **34** FIG. **1**, and the computing entities **20-1** through **20**-N (e.g., associated with multiple areas of large building, associated with multiple buildings of a large geographic area).

(181) The head unit system includes the secondary object sensor. The set of secondary objects is associated with the object (e.g., a group of people go through the door).

(182) The head unit **10-1** includes a shear thickening fluid (STF) **42**. The STF is configured to have a decreasing viscosity in response to a first range of shear rates and an increasing viscosity in response to a second range of shear rates as discussed with reference to FIG. **1**B. The second range of shear rates are greater than the first range of shear rates.

(183) The head unit further includes a chamber **16**. The chamber is configured to contain a portion of the STF and includes a front channel **26** and a back channel **24**.

(184) The head unit further includes a piston **36** housed at least partially radially within the chamber **16** and separating the back channel **24** and the front channel **26**. The piston is configured to exert pressure against the shear thickening fluid in response to movement of the piston from a force applied to the piston from the object **12-1**. The movement of the piston includes one of traveling through the chamber in an inward direction or traveling through the chamber in an

outward direction. The piston travels toward the back channel and away from the front channel when traveling in the inward direction. The piston travels toward the front channel and away from the back channel when traveling in the outward direction.
(185) The piston **36** includes a first piston bypass **38-1** between opposite sides of the piston that controls flow of the STF **42** between the opposite sides of the piston from the back channel to the front channel when the piston is traveling through the chamber in the inward direction to cause the STF to react with a first shear threshold effect.
(186) The piston **36** further includes a second piston bypass **38-2** between the opposite sides of the piston that controls flow of the STF between the opposite sides of the piston from the front channel to the back channel when the piston is traveling through the chamber in the outward direction to cause the STF to react with a second shear threshold effect.
(187) The head unit **10-1** further includes a set of fluid flow sensors **116-1-1** and **116-1-2** positioned proximal to the chamber **16**. The set of fluid flow sensors provide the fluid response **232-1-1** and **232-1-2** respectively from the STF **42**.
(188) The head unit **10-1** further includes set of fluid manipulation emitters **114-1-1** and **114-1-2** positioned proximal to the chamber **16**. The set of fluid manipulation emitters provide a fluid activation to at least one of the STF **42** (e.g., shifting the shear rate versus viscosity curve), the first piston bypass **38-1** (e.g., to block or allow flow of the STF), and the second piston bypass **38-2** to control the motion of the object **12-1** with regards to the set of secondary objects (e.g., avoiding a collision between the door and the group people).
(189) FIG. **9**A illustrates an example of operation of a method for the controlling the operational aspects. A first step of the example of operation includes the piston **36** moving outward away from the head unit **10-1** when the object **12-1** exerts a pulling force on the plunger **28** that transfers the force to the piston **36**. As a result, the piston **36** exerts the force on the STF **42** within the front channel **26**.
(190) A second step of the example of operation includes the computing entity **20-1** interpreting a fluid response from the set of fluid flow sensors to produce a piston velocity **182** and a piston position **184** of the piston **36** associated with a head unit device of a head unit system. The set of fluid flow sensors are positioned proximal to the head unit device for controlling motion of the object **12-1** within the internal environment. For example, the computing entity **20-1** interprets fluid responses **232-1-1** and **232-1-2** from the STF **42** in response to varying responsiveness of particles of the STF to produce the piston velocity and the piston position.
(191) The interpreting the fluid response from the set of fluid flow sensors to produce the piston velocity and the piston position of the piston includes a series of sub-steps. A first sub-step includes inputting, from one or more fluid flow sensors of the set of fluid flow sensors, a set of fluid flow signals over a time range. For example, the computing entity **20-1** receives fluid responses **232-1-1** and **232-1-2** over the time range, where the fluid responses include the fluid flow signals.
(192) A second sub-step includes determining the fluid response of the set of fluid flow sensors based on the set of fluid flow signals. For example, the computing entity **20-1** interprets the fluid flow signals to produce the fluid response.
(193) A third sub-step includes determining the piston velocity based on the fluid response of the set of fluid flow sensors over the time range. For example, the computing entity **20-1** calculates piston velocity based on changes in the fluid response over the time range.
(194) A fourth sub-step includes determining the piston position based on the piston velocity and a real-time reference. For example, the computing entity **20-1** calculates the piston position based on time in the piston velocity as the piston moves through the chamber.
(195) As yet another example of interpreting the fluid response **232-1-1** and **232-1-2**, the computing entity **20-1** compares the fluid response **232-1-1** and **232-1-2** to previous measurements of fluid flow versus piston velocity and piston position to produce the piston velocity **182** and piston position **184**. As a still further example of the interpreting the fluid response **232-1-1** and

232-1-2, the computing entity **20-1** extracts the piston velocity **182** and the piston position **184** directly from the fluid response **232-1-1** and/or **232-1-2** when the sensors **116-1-1** and **116-1-2** generate the piston velocity and piston position directly.

(196) The second step of the example of operation further includes the computing entity **20-1** determining a shear force **186** based on the piston velocity **182** and the piston position **184**. The determining the shear force based on the piston velocity and the piston position includes one approach of a variety of approaches. A first approach includes extracting the shear force directly from the fluid response when one or more fluid flow sensors of the set of fluid flow sensors outputs a shear force encoded signal. For example, the computing entity **20-1** extracts the shear force **186** directly from the fluid responses **232-1-1** and **232-1-2**. In an instance, the shear force **186** reveals the piston velocity versus force applied to the piston curve as illustrated in FIG. **9**A, where at a current time of interpreting the fluid flow response, the force and piston velocity are at a point Y**3** (e.g., a negative velocity since moving in the outward direction).

(197) A second approach includes determining the shear force utilizing the piston velocity and stored data for piston velocity versus shear force for the STF. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42**.

(198) A third approach includes determining the shear force utilizing the piston position and stored data for piston position and a piston bypass versus shear force for the STF within the chamber. For example, the computing entity **20-1** compares the velocity and position to stored data for instantaneous velocity and position versus shear force for the STF **42** based on an actual valve opening status of the second piston bypass **38-2** (e.g., which allows flow of the STF from the front channel **26** to the back channel **24** when the piston is moving in the outward direction of the example).

(199) A third step of the example of operation includes the computing entity **20-1** interpreting an output of the secondary object sensor to produce and object pattern of the set of secondary objects. The object pattern includes the object type as previously discussed and activity parameters associated with objects of the object type. The activity parameters includes a person walking, a person running, a group of people walking, a group of people running, a set of secondary objects moving towards the object, the set of second area objects moving away from the object, and/or any other possible activity type associated with one or more of the secondary objects.

(200) The interpreting includes interpreting environment sensor information **150** from the secondary object sensor (e.g., from the environment sensor module **14**), comparing the environment sensor information **150** to previously stored information for object patterns, and selecting the object pattern when a match is detected. For example, the computing entity **20-1** compares a video clip of the environment sensor information **152** a stored video clip of a group of people walking towards a door and identifies the object pattern as a group of people walking when matching the video clip of the environment sensor information **150** to the stored video clip of the person walking.

(201) FIG. **9**B further illustrates the example of operation, where having determined the object pattern for the group of secondary objects, in a fourth step the computing entity **20-1** identifies historical results for other objects based on the object pattern of the set of secondary objects. For example, the computing entity **20-1** compares the object pattern to historical results **155** from the chamber database **34**. The other computing entities **20-2** through **20-1** contribute to the historical results by generating the historical results based on other object patterns associated with the other computing entities, corresponding utilized fluid activations for those other object patterns, and actual results from the utilization of the fluid activations (e.g., unfavorable results including late door openings and early door closings; a verbal results including door openings and closings matched with actual needs).

(202) Having compared the object pattern to the historical results **155**, the computing entity **20-1**

identifies the fluid activations utilized for favorable results for similar object patterns. Having identified the historical results, a fifth step of the method of operation includes the computing entity **20-1** determining the fluid activation **187** for the head unit based on the object pattern for the set of secondary objects and one or more of the piston velocity, the piston position, and the shear force **186**.

(203) As an example of the determining of the fluid activation **187**, the computing entity **20-1** establishes the fluid activation **187** to facilitate closing of a large exterior door more quickly, yet safely, when the object pattern of the set of secondary objects is one person approaching the door and the historical results **155** indicates that a faster closing for one person is generally favorable. As another example, the computing entity **20-1** establishes the fluid activation **187** to facilitate opening of the large exterior door more slowly when the object pattern of the set of secondary objects is a group of people mulling around that could be in the way of the door opening and the historical results **155** indicates that a slower opening when people may be in the way of the opening door is generally favorable.

(204) In particular, the computing entity **20-1** determines the fluid activation **187** to adjust the viscosity of the STF to facilitate movement of the piston and hence door in a more desirable fashion based on the identified object pattern for the set of secondary objects and based on the historical results. The determining the fluid activation **187** includes a variety of approaches. A first approach includes opening of either of the piston bypass **38-1** and piston bypass **38-2** allow the STF to move between the back channel **24** and the front channel **26** to lower the shear rate and thus select a lower viscosity which in turn allows more rapid movement of the piston in the chamber and hence speeds up the door. A second approach includes opening of the chamber bypass **42** to lower the viscosity the STF. A third approach includes activating the set of emitters to directly alter the viscosity of the STF in a desired fashion (e.g., lowering viscosity to speed up opening or closing of the door, raising viscosity to slow down the opening or the closing of the door).

(205) A sixth step of the example method of operation includes the computing entity **20-1** activating the set of fluid manipulation emitters **114-1-1** and **114-1-2** in accordance with the fluid activation **187** to manipulate one of the first shear threshold effect associated with the first piston bypass **38-1** and the second shear threshold effect associated with the second piston bypass **38-2** to control the motion of the object **12-1** to control the motion of the object with regards to the set of secondary objects. For example, when the object **12-1** includes a large garage door and is opening when moving in the outward direction, the computing entity **20-1** outputs the fluid activation **234-1-1** to the piston bypass **38-2** to facilitate further opening of a one-way check valve to allow more of the STF to move from the front channel **26** to the back channel **24** thusly selecting the first range of shear rates and a lower viscosity of the STF to speed up the door to open when the detected set of secondary objects is a large vehicle passing through the large garage door when the historical results indicate that it is favorable to open the door quickly when the vehicle is very large.

(206) As another example, when the set of secondary objects **12-2** through **12-**N includes a group of people, the computing entity **20-1** outputs the fluid activation **234-1-1** to the piston bypass **38-2** to facilitate closing down the one-way check valve to prevent STF from moving from the front channel **26** to the back channel **24** thusly selecting the second range of shear rates and a higher viscosity the STF to slow down a heavy door to close safely moving from the point Y**3** to the point Y**4** (e.g., when the piston is moving in the outward direction) as illustrated in FIG. **9**B when the historical results indicate that it is favorable to slow down the closing of the heavy door.

(207) The method described above in conjunction with a processing module of any computing entity of the mechanical and computing system of FIG. **1** can alternatively be performed by other modules of the system of FIG. **1** or by other devices. In addition, at least one memory section that is non-transitory (e.g., a non-transitory computer readable storage medium, a non-transitory computer readable memory organized into a first memory element, a second memory element, a third memory element, a fourth element section, a fifth memory element, a sixth memory element,

etc.) that stores operational instructions can, when executed by one or more processing modules of the one or more computing entities of the computing system **10**, cause one or more computing devices of the mechanical and computing system of FIG. **1** to perform any or all of the method steps described above.

(208) It is noted that terminologies as may be used herein such as bit stream, stream, signal sequence, etc. (or their equivalents) have been used interchangeably to describe digital information whose content corresponds to any of a number of desired types (e.g., data, video, speech, text, graphics, audio, etc. any of which may generally be referred to as 'data').

(209) As may be used herein, the terms "substantially" and "approximately" provides an industry-accepted tolerance for its corresponding term and/or relativity between items. For some industries, an industry-accepted tolerance is less than one percent and, for other industries, the industry-accepted tolerance is 10 percent or more. Other examples of industry-accepted tolerance range from less than one percent to fifty percent. Industry-accepted tolerances correspond to, but are not limited to, component values, integrated circuit process variations, temperature variations, rise and fall times, thermal noise, dimensions, signaling errors, dropped packets, temperatures, pressures, material compositions, and/or performance metrics. Within an industry, tolerance variances of accepted tolerances may be more or less than a percentage level (e.g., dimension tolerance of less than +/−1%). Some relativity between items may range from a difference of less than a percentage level to a few percent. Other relativity between items may range from a difference of a few percent to magnitude of differences.

(210) As may also be used herein, the term(s) "configured to", "operably coupled to", "coupled to", and/or "coupling" includes direct coupling between items and/or indirect coupling between items via an intervening item (e.g., an item includes, but is not limited to, a component, an element, a circuit, and/or a module) where, for an example of indirect coupling, the intervening item does not modify the information of a signal but may adjust its current level, voltage level, and/or power level. As may further be used herein, inferred coupling (i.e., where one element is coupled to another element by inference) includes direct and indirect coupling between two items in the same manner as "coupled to".

(211) As may even further be used herein, the term "configured to", "operable to", "coupled to", or "operably coupled to" indicates that an item includes one or more of power connections, input(s), output(s), etc., to perform, when activated, one or more its corresponding functions and may further include inferred coupling to one or more other items. As may still further be used herein, the term "associated with", includes direct and/or indirect coupling of separate items and/or one item being embedded within another item.

(212) As may be used herein, the term "compares favorably", indicates that a comparison between two or more items, signals, etc., provides a desired relationship. For example, when the desired relationship is that signal **1** has a greater magnitude than signal **2**, a favorable comparison may be achieved when the magnitude of signal **1** is greater than that of signal **2** or when the magnitude of signal **2** is less than that of signal **1**. As may be used herein, the term "compares unfavorably", indicates that a comparison between two or more items, signals, etc., fails to provide the desired relationship.

(213) As may be used herein, one or more claims may include, in a specific form of this generic form, the phrase "at least one of a, b, and c" or of this generic form "at least one of a, b, or c", with more or less elements than "a", "b", and "c". In either phrasing, the phrases are to be interpreted identically. In particular, "at least one of a, b, and c" is equivalent to "at least one of a, b, or c" and shall mean a, b, and/or c. As an example, it means: "a" only, "b" only, "c" only, "a" and "b", "a" and "c", "b" and "c", and/or "a", "b", and "c".

(214) As may also be used herein, the terms "processing module", "processing circuit", "processor", "processing circuitry", and/or "processing unit" may be a single processing device or a plurality of processing devices. Such a processing device may be a microprocessor, micro-

controller, digital signal processor, microcomputer, central processing unit, field programmable gate array, programmable logic device, state machine, logic circuitry, analog circuitry, digital circuitry, and/or any device that manipulates signals (analog and/or digital) based on hard coding of the circuitry and/or operational instructions. The processing module, module, processing circuit, processing circuitry, and/or processing unit may be, or further include, memory and/or an integrated memory element, which may be a single memory device, a plurality of memory devices, and/or embedded circuitry of another processing module, module, processing circuit, processing circuitry, and/or processing unit. Such a memory device may be a read-only memory, random access memory, volatile memory, non-volatile memory, static memory, dynamic memory, flash memory, cache memory, and/or any device that stores digital information. Note that if the processing module, module, processing circuit, processing circuitry, and/or processing unit includes more than one processing device, the processing devices may be centrally located (e.g., directly coupled together via a wired and/or wireless bus structure) or may be distributedly located (e.g., cloud computing via indirect coupling via a local area network and/or a wide area network). Further note that if the processing module, module, processing circuit, processing circuitry and/or processing unit implements one or more of its functions via a state machine, analog circuitry, digital circuitry, and/or logic circuitry, the memory and/or memory element storing the corresponding operational instructions may be embedded within, or external to, the circuitry comprising the state machine, analog circuitry, digital circuitry, and/or logic circuitry. Still further note that, the memory element may store, and the processing module, module, processing circuit, processing circuitry and/or processing unit executes, hard coded and/or operational instructions corresponding to at least some of the steps and/or functions illustrated in one or more of the Figures. Such a memory device or memory element can be included in an article of manufacture.

(215) One or more embodiments have been described above with the aid of method steps illustrating the performance of specified functions and relationships thereof. The boundaries and sequence of these functional building blocks and method steps have been arbitrarily defined herein for convenience of description. Alternate boundaries and sequences can be defined so long as the specified functions and relationships are appropriately performed. Any such alternate boundaries or sequences are thus within the scope and spirit of the claims. Further, the boundaries of these functional building blocks have been arbitrarily defined for convenience of description. Alternate boundaries could be defined as long as the certain significant functions are appropriately performed. Similarly, flow diagram blocks may also have been arbitrarily defined herein to illustrate certain significant functionality.

(216) To the extent used, the flow diagram block boundaries and sequence could have been defined otherwise and still perform the certain significant functionality. Such alternate definitions of both functional building blocks and flow diagram blocks and sequences are thus within the scope and spirit of the claims. One of average skill in the art will also recognize that the functional building blocks, and other illustrative blocks, modules, and components herein, can be implemented as illustrated or by discrete components, application specific integrated circuits, processors executing appropriate software and the like or any combination thereof.

(217) In addition, a flow diagram may include a “start” and/or “continue” indication. The “start” and “continue” indications reflect that the steps presented can optionally be incorporated in or otherwise used in conjunction with one or more other routines. In addition, a flow diagram may include an “end” and/or “continue” indication. The “end” and/or “continue” indications reflect that the steps presented can end as described and shown or optionally be incorporated in or otherwise used in conjunction with one or more other routines. In this context, “start” indicates the beginning of the first step presented and may be preceded by other activities not specifically shown. Further, the “continue” indication reflects that the steps presented may be performed multiple times and/or may be succeeded by other activities not specifically shown. Further, while a flow diagram indicates a particular ordering of steps, other orderings are likewise possible provided that the

principles of causality are maintained.
(218) The one or more embodiments are used herein to illustrate one or more aspects, one or more features, one or more concepts, and/or one or more examples. A physical embodiment of an apparatus, an article of manufacture, a machine, and/or of a process may include one or more of the aspects, features, concepts, examples, etc. described with reference to one or more of the embodiments discussed herein. Further, from figure to figure, the embodiments may incorporate the same or similarly named functions, steps, modules, etc. that may use the same or different reference numbers and, as such, the functions, steps, modules, etc. may be the same or similar functions, steps, modules, etc. or different ones.
(219) Unless specifically stated to the contra, signals to, from, and/or between elements in a figure of any of the figures presented herein may be analog or digital, continuous time or discrete time, and single-ended or differential. For instance, if a signal path is shown as a single-ended path, it also represents a differential signal path. Similarly, if a signal path is shown as a differential path, it also represents a single-ended signal path. While one or more particular architectures are described herein, other architectures can likewise be implemented that use one or more data buses not expressly shown, direct connectivity between elements, and/or indirect coupling between other elements as recognized by one of average skill in the art.
(220) The term "module" is used in the description of one or more of the embodiments. A module implements one or more functions via a device such as a processor or other processing device or other hardware that may include or operate in association with a memory that stores operational instructions. A module may operate independently and/or in conjunction with software and/or firmware. As also used herein, a module may contain one or more sub-modules, each of which may be one or more modules.
(221) As may further be used herein, a computer readable memory includes one or more memory elements. A memory element may be a separate memory device, multiple memory devices, or a set of memory locations within a memory device. Such a memory device may be a read-only memory, random access memory, volatile memory, non-volatile memory, static memory, dynamic memory, flash memory, cache memory, a quantum register or other quantum memory and/or any other device that stores data in a non-transitory manner. Furthermore, the memory device may be in a form of a solid-state memory, a hard drive memory or other disk storage, cloud memory, thumb drive, server memory, computing device memory, and/or other non-transitory medium for storing data. The storage of data includes temporary storage (i.e., data is lost when power is removed from the memory element) and/or persistent storage (i.e., data is retained when power is removed from the memory element). As used herein, a transitory medium shall mean one or more of: (a) a wired or wireless medium for the transportation of data as a signal from one computing device to another computing device for temporary storage or persistent storage; (b) a wired or wireless medium for the transportation of data as a signal within a computing device from one element of the computing device to another element of the computing device for temporary storage or persistent storage; (c) a wired or wireless medium for the transportation of data as a signal from one computing device to another computing device for processing the data by the other computing device; and (d) a wired or wireless medium for the transportation of data as a signal within a computing device from one element of the computing device to another element of the computing device for processing the data by the other element of the computing device. As may be used herein, a non-transitory computer readable memory is substantially equivalent to a computer readable memory. A non-transitory computer readable memory can also be referred to as a non-transitory computer readable storage medium.
(222) While particular combinations of various functions and features of the one or more embodiments have been expressly described herein, other combinations of these features and functions are likewise possible. The present disclosure is not limited by the particular examples disclosed herein and expressly incorporates these other combinations.

Claims

1. A head unit system for controlling motion of an object, the head unit system comprising: a secondary object sensor for sensing a secondary object, wherein the secondary object is associated with the object; and a head unit device, wherein the head unit device includes: a shear thickening fluid (STF), wherein the STF is configured to have a decreasing viscosity in response to a first range of shear rates and an increasing viscosity in response to a second range of shear rates, wherein the second range of shear rates are greater than the first range of shear rates; a chamber, the chamber configured to contain a portion of the STF, wherein the chamber includes a front channel and a back channel; a piston housed at least partially radially within the chamber and separating the back channel and the front channel, the piston configured to exert pressure against the shear thickening fluid in response to movement of the piston from a force applied to the piston from the object, wherein the movement of the piston includes one of traveling through the chamber in an inward direction or traveling through the chamber in an outward direction, wherein the piston travels toward the back channel and away from the front channel when traveling in the inward direction, wherein the piston travels toward the front channel and away from the back channel when traveling in the outward direction, wherein the piston includes at least one of: a first piston bypass between opposite sides of the piston that controls flow of the STF between the opposite sides of the piston between the back channel and the front channel to cause the STF to react with a first shear threshold effect, and a second piston bypass between the opposite sides of the piston that controls flow of the STF between the opposite sides of the piston between the front channel and the back channel to cause the STF to react with a second shear threshold effect; a set of fluid flow sensors positioned proximal to the chamber, wherein the set of fluid flow sensors provide a fluid response from the STF; and a set of fluid manipulation emitters positioned proximal to the chamber, wherein the set of fluid manipulation emitters provide a fluid activation to at least one of the STF, the first piston bypass, and the second piston bypass to control the motion of the object.
2. The head unit system of claim 1, wherein the head unit device further comprises: a plunger between the object and the piston, the plunger configured to apply the force from the object to move the piston within the chamber; and a plunger bushing to guide the plunger into the chamber in response to the force from the object, wherein the plunger bushing facilitates containment of the STF within the chamber, wherein the plunger bushing remains in a fixed position relative to the chamber when the force from the object moves the piston within the chamber.
3. The head unit system of claim 1, wherein the STF comprises: a plurality of nanoparticles, wherein the plurality of nanoparticles includes one or more of an oxide, calcium carbonate, synthetically occurring minerals, naturally occurring minerals, polymers, SiO2, polystyrene, polymethylmethacrylate, or a mixture thereof; and one or more of ethylene glycol, polyethylene glycol, ethanol, silicon oils, phenyltrimethicone, or a mixture thereof.
4. The head unit system of claim 1, wherein the head unit device further comprises: a chamber bypass between opposite ends of the chamber, wherein the chamber bypass facilitates flow of a portion of the STF between the opposite ends of the chamber when the piston travels through the chamber in the inward or the outward direction.
5. The head unit system of claim 1, wherein the head unit device further comprises: when the piston is traveling through the chamber in the inward direction the first shear threshold effect includes: the first range of shear rates when the STF is configured to have the decreasing viscosity, and the second range of shear rates when the STF is configured to have the increasing viscosity; and when the piston is traveling through the chamber in the outward direction the second shear threshold effect includes: the first range of shear rates when the STF is configured to have the decreasing viscosity, and the second range of shear rates when the STF is configured to have the increasing viscosity.

6. The head unit system of claim 1, wherein the first piston bypass comprises: one or more of a one-way check valve and a variable flow valve; when the piston is traveling through the chamber in the inward direction: a first setting of the variable flow valve facilitates the first range of shear rates when the STF is to have the decreasing viscosity, and a second setting of the variable flow valve facilitates the second range of shear rates when the STF is to have the increasing viscosity; and when the piston is traveling through the chamber in the outward direction: the one-way check valve is configured to prevent STF flow through the first piston bypass.
7. The head unit system of claim 1, wherein the second piston bypass comprises: one or more of a one-way check valve and a variable flow valve; when the piston is traveling through the chamber in the inward direction: the one-way check valve is configured to prevent STF flow through the second piston bypass; and when the piston is traveling through the chamber in the outward direction: a first setting of the variable flow valve facilitates the first range of shear rates when the STF is to have the decreasing viscosity, and a second setting of the variable flow valve facilitates the second range of shear rates when the STF is to have the increasing viscosity.
8. The head unit system of claim 1, wherein the set of fluid flow sensors comprises one or more of: a valve opening detector associated with one or more of the first piston bypass and the second piston bypass, a mechanical position sensor, an image sensor, a light sensor, an audio sensor, a microphone, an ultrasonic sound sensor, an electric field sensor, a magnetic field sensor, and a radio frequency wireless field sensor.
9. The head unit system of claim 1, wherein the set of fluid manipulation emitters comprises one or more of: a variable flow valve associated with one or more of the first piston bypass and the second piston bypass, a mechanical vibration generator, an image generator, a light emitter, an audio transducer, a speaker, an ultrasonic sound transducer, an electric field generator, a magnetic field generator, and a radio frequency wireless field transmitter.
10. A method for execution by a computing device, the method comprises: interpreting a fluid response from a set of fluid flow sensors to produce a piston velocity and a piston position of a piston associated with a head unit device of a head unit system, wherein the set of fluid flow sensors are positioned proximal to the head unit device for controlling motion of an object with regards to a secondary object, wherein the head unit system includes: a secondary object sensor for sensing the secondary object, wherein the secondary object is associated with the object, and the head unit device, wherein the head unit device includes: a shear thickening fluid (STF), wherein the STF is configured to have a decreasing viscosity in response to a first range of shear rates and an increasing viscosity in response to a second range of shear rates, wherein the second range of shear rates are greater than the first range of shear rates, a chamber, the chamber configured to contain a portion of the STF, wherein the chamber includes a front channel and a back channel, the piston housed at least partially radially within the chamber and separating the back channel and the front channel, the piston configured to exert pressure against the shear thickening fluid in response to movement of the piston from a force applied to the piston from the object, wherein the movement of the piston includes one of traveling through the chamber in an inward direction or traveling through the chamber in an outward direction, wherein the piston travels toward the back channel and away from the front channel when traveling in the inward direction, wherein the piston travels toward the front channel and away from the back channel when traveling in the outward direction, wherein the piston includes at least one of: a first piston bypass between opposite sides of the piston that controls flow of the STF between the opposite sides of the piston between the back channel and the front channel to cause the STF to react with a first shear threshold effect, and a second piston bypass between the opposite sides of the piston that controls flow of the STF between the opposite sides of the piston between the front channel and the back channel to cause the STF to react with a second shear threshold effect, the set of fluid flow sensors positioned proximal to the chamber, wherein the set of fluid flow sensors provide a fluid response from the STF, and a set of fluid manipulation emitters positioned proximal to the chamber, wherein the set of

fluid manipulation emitters provide a fluid activation to at least one of the STF, the first piston bypass, and the second piston bypass to control the motion of the object; interpreting an output of the secondary object sensor to produce an object type for the secondary object; determining the fluid activation for the head unit device based on the object type of the secondary object and one or more of the piston velocity and the piston position; and activating the set of fluid manipulation emitters in accordance with the fluid activation to control the motion of the object with regards to the secondary object, wherein the control of the motion of the object includes one or more of direct manipulation of the STF, facilitation of the first shear threshold effect associated with the first piston bypass, and facilitation of the second shear threshold effect associated with the second piston bypass.

11. The method of claim 10 further comprises: interpreting the output of the secondary object sensor to further update the object type of the secondary object to produce a further updated object type of the secondary object; and updating the fluid activation for the head unit device based on the further updated object type of the secondary object and one or more of the piston velocity and the piston position.

12. The method of claim 10, wherein the interpreting the output of the secondary object sensor to produce the object type of the secondary object comprises: obtaining environment sensor information from the secondary object sensor for the secondary object; identifying activity parameters from the environment sensor information for the secondary object; and identifying the object type of the secondary object based on the activity parameters from the environment sensor information for the secondary object.

13. The method of claim 10, wherein the determining the fluid activation for the head unit device based on the object type of the secondary object and one or more of the piston velocity and the piston position comprises one or more of: interpreting a request associated with modifying one or more of object velocity and object position; interpreting fluid activation guidance from a chamber database based on the object type of the secondary object; interpreting activity information from the chamber database based on the object type of the secondary object to produce an object movement recommendation, wherein a correlation between the activity information and the object type of the secondary object suggests an expected movement behavior of the secondary object; determining a position for the secondary object based on the output of the secondary object sensor; determining an object position for the object based on the piston velocity and the piston position; establishing the fluid activation to include facilitating the first range of shear rates when the object movement recommendation includes increasing velocity of the object; and establishing the fluid activation to include facilitating the second range of shear rates when the object movement recommendation includes decreasing the velocity of the object.

14. The method of claim 10, wherein the activating the set of fluid manipulation emitters in accordance with the fluid activation to control the motion of the object with regards to the secondary object comprises: when the piston is traveling through the chamber in the inward direction: when the STF is to have the decreasing viscosity: issuing the fluid activation to the set of fluid manipulation emitters to cause one of: the first piston bypass to facilitate the first shear threshold effect to include the first range of shear rates, and the direct manipulation of the STF to facilitate the first range of shear rates; and when the STF is to have the increasing viscosity: issuing the fluid activation to the set of fluid manipulation emitters to cause one of: the first piston bypass to facilitate the first shear threshold effect to include the second range of shear rates, and the direct manipulation of the STF to facilitate the second range of shear rates; and when the piston is traveling through the chamber in the outward direction: when the STF is to have the decreasing viscosity: issuing the fluid activation to the set of fluid manipulation emitters to cause one of: the second piston bypass to facilitate the second shear threshold effect to include the first range of shear rates, and the direct manipulation of the STF to facilitate the first range of shear rates; and when the STF is to have the increasing viscosity: issuing the fluid activation to the set of fluid

manipulation emitters to cause one of: the second piston bypass to facilitate the second shear threshold effect to include the second range of shear rates, and the direct manipulation of the STF to facilitate the second range of shear rates.

15. A non-transitory computer readable memory comprises: a first memory element that stores operational instructions that, when executed by a processing module, causes the processing module to: interpret a fluid response from a set of fluid flow sensors to produce a piston velocity and a piston position of a piston associated with a head unit device of a head unit system, wherein the set of fluid flow sensors are positioned proximal to the head unit device for controlling motion of an object with regards to a secondary object, wherein the head unit system includes: a secondary object sensor for sensing the secondary object, wherein the secondary object is associated with the object, and the head unit device, wherein the head unit device includes: a shear thickening fluid (STF), wherein the STF is configured to have a decreasing viscosity in response to a first range of shear rates and an increasing viscosity in response to a second range of shear rates, wherein the second range of shear rates are greater than the first range of shear rates, a chamber, the chamber configured to contain a portion of the STF, wherein the chamber includes a front channel and a back channel, the piston housed at least partially radially within the chamber and separating the back channel and the front channel, the piston configured to exert pressure against the shear thickening fluid in response to movement of the piston from a force applied to the piston from the object, wherein the movement of the piston includes one of traveling through the chamber in an inward direction or traveling through the chamber in an outward direction, wherein the piston travels toward the back channel and away from the front channel when traveling in the inward direction, wherein the piston travels toward the front channel and away from the back channel when traveling in the outward direction, wherein the piston includes at least one of: a first piston bypass between opposite sides of the piston that controls flow of the STF between the opposite sides of the piston between the back channel and the front channel to cause the STF to react with a first shear threshold effect, and a second piston bypass between the opposite sides of the piston that controls flow of the STF between the opposite sides of the piston between the front channel and the back channel to cause the STF to react with a second shear threshold effect, the set of fluid flow sensors positioned proximal to the chamber, wherein the set of fluid flow sensors provide a fluid response from the STF, and a set of fluid manipulation emitters positioned proximal to the chamber, wherein the set of fluid manipulation emitters provide a fluid activation to at least one of the STF, the first piston bypass, and the second piston bypass to control the motion of the object; a second memory element that stores operational instructions that, when executed by the processing module, causes the processing module to: interpret an output of the secondary object sensor to produce an object type for the secondary object; a third memory element that stores operational instructions that, when executed by the processing module, causes the processing module to: determine the fluid activation for the head unit device based on the object type of the secondary object and one or more of the piston velocity and the piston position; and a fourth memory element that stores operational instructions that, when executed by the processing module, causes the processing module to: activate the set of fluid manipulation emitters in accordance with the fluid activation to control the motion of the object with regards to the secondary object, wherein the control of the motion of the object includes one or more of direct manipulation of the STF, facilitation of the first shear threshold effect associated with the first piston bypass, and facilitation of the second shear threshold effect associated with the second piston bypass.

16. The non-transitory computer readable memory of claim 15 further comprises: a fifth memory element that stores operational instructions that, when executed by the processing module, causes the processing module to: interpret the output of the secondary object sensor to further update the object type of the secondary object to produce a further updated object type of the secondary object; and update the fluid activation for the head unit device based on the further updated object type of the secondary object and one or more of the piston velocity and the piston position.

17. The non-transitory computer readable memory of claim 15, wherein the processing module performs functions to execute the operational instructions stored by the second memory element to cause the processing module to interpret the output of the secondary object sensor to produce the object type of the secondary by: obtaining environment sensor information from the secondary object sensor for the secondary object; identifying activity parameters from the environment sensor information for the secondary object; and identifying the object type of the secondary object based on the activity parameters from the environment sensor information for the secondary object.
18. The non-transitory computer readable memory of claim 15, wherein the processing module performs functions to execute the operational instructions stored by the third memory element to cause the processing module to determine the fluid activation for the head unit device based on the object type of the secondary object and one or more of the piston velocity and the piston position by one or more of: interpreting a request associated with modifying one or more of object velocity and object position; interpreting fluid activation guidance from a chamber database based on the object type of the secondary object; interpreting activity information from the chamber database based on the object type of the secondary object to produce an object movement recommendation, wherein a correlation between the activity information and the object type of the secondary object suggests an expected movement behavior of the secondary object; determining a position for the secondary object based on the output of the secondary object sensor; determining an object position for the object based on the piston velocity and the piston position; establishing the fluid activation to include facilitating the first range of shear rates when the object movement recommendation includes increasing velocity of the object; and establishing the fluid activation to include facilitating the second range of shear rates when the object movement recommendation includes decreasing the velocity of the object.
19. The non-transitory computer readable memory of claim 15, wherein the processing module performs functions to execute the operational instructions stored by the fourth memory element to cause the processing module to activate the set of fluid manipulation emitters in accordance with the fluid activation to control the motion of the object with regards to the secondary object by: when the piston is traveling through the chamber in the inward direction: when the STF is to have the decreasing viscosity: issuing the fluid activation to the set of fluid manipulation emitters to cause one of: the first piston bypass to facilitate the first shear threshold effect to include the first range of shear rates, and the direct manipulation of the STF to facilitate the first range of shear rates; and when the STF is to have the increasing viscosity: issuing the fluid activation to the set of fluid manipulation emitters to cause one of: the first piston bypass to facilitate the first shear threshold effect to include the second range of shear rates, and the direct manipulation of the STF to facilitate the second range of shear rates; and when the piston is traveling through the chamber in the outward direction: when the STF is to have the decreasing viscosity: issuing the fluid activation to the set of fluid manipulation emitters to cause one of: the second piston bypass to facilitate the second shear threshold effect to include the first range of shear rates, and the direct manipulation of the STF to facilitate the first range of shear rates; and when the STF is to have the increasing viscosity: issuing the fluid activation to the set of fluid manipulation emitters to cause one of: the second piston bypass to facilitate the second shear threshold effect to include the second range of shear rates, and the direct manipulation of the STF to facilitate the second range of shear rates.