MODULAR DATA ACQUISITION FOR DRILLING OPERATIONS

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ABSTRACT

Data associated with drilling operations, downhole components, wellbores, or well formations can be acquired by providing one or more data acquisition modules having one or more sensors in one or more recessed chambers formed within a drill bit, stabilizer reamer, or other downhole tool, enabling direct rather than inferential data to be obtained for analysis. The modules can be programmed with pre-selected trigger thresholds, such that data acquisition is initiated when certain conditions are met, and can be interchanged with other types of modules at the surface.
MODULAR DATA ACQUISITION FOR DRILLING OPERATIONS

FIELD

Embodiments usable within the scope of the present disclosure relate, generally, to downhole tools, such as drill bits, reamers, stabilizers, drill collars, and similar bottomhole and/or downhole components, having data acquisition modules in association therewith for contemporaneously acquiring data pertaining to conditions at the drill bit and/or throughout the drill string relative to and during drilling operations.

BACKGROUND

The oil and gas industry has expended many man hours and dollars in the design of drill bits, downhole tools, and drill string elements. The drill bit, by interacting with the rock face and removing formation, is the focus of the majority of the energy expended during rotary or other downhole operations, with the design of the drilling rig, the drill string, and many other facets of drilling being directed to support and enhance the performance of the drill bit. Many factors affect the performance (e.g., rate of penetration) of the drill string and the interaction between the drill bit and the formation, and it is often desirable to measure and/or record such factors.

In particular, it is of high utility to identify and understand vibrations induced on the drill string during operations. Induced vibrations can affect the drill string in many ways, including among other things component failures, bent drill pipes, wellbore deviation, broken drill bits and the loss of entire drill strings.

Conventional methods of acquiring data at or proximate to the drill bit include the use of subs immediately above the bit and complicated systems designed within the drill bit itself. The use of a dedicated sub for this purpose adds an additional, often undesirable element, to the drill string, such as the addition of another source of vibration or vibrational weakness. Likewise, systems designed within the drill bit itself involve complex bit and electronic designs that can compromise the robustness of the drill bit and add potential avenues for failure, thus reducing drill string reliability.

Data acquisition from other portions of the drill string, such as portions containing stabilizers and reamers, traditionally requires use of logging-while-drilling (LWD) or measurement-while-drilling (MWD) tools to gather data and interpret performance of such elements of the drill string. While useful to a degree, this data relies heavily on mathematical approximations which can vary greatly from drill string to drill string and from formation to formation. These mathematical simulations rely on multiple layers of inferential models and approximations that do not have the accuracy needed in the field to pinpoint, for example, the source of drill string failure. These systems rely on single-point data acquisition methods ostensibly used to monitor multiple sources of vibrational damage. Therefore, the ability of LWD and MWD tools to identify the source of failure in a drill string is low. Much greater accuracy would be available using a method which places multiple sensors in multiple locations on a drill string in such a way as not to reduce or negatively affect the robustness of the drill string.

Critically, current efforts to gather vibration data during drilling operations have reduced the robustness of the drill strings so as to increase the likelihood of failure.

A need exists for a robust, flexible method of data acquisition that is highly reliable and that requires minimal modifications to existing drill bits and/or other downhole tools, thus minimizing any potential impact on the durability, performance or operation of such tools, while gathering data to improve bit design, vibration control or mitigation, and similar factors to improve drilling rates and performance. A further need exists for flexible methods in which sensor elements associated with a drill bit or other downhole tools can be quickly and conveniently interchanged to gather other and/or additional types of data, such as during times when a drill bit is changed after becoming dull. A further need exists for the data collection in a drill string which does not rely on inferential mathematical models. A further need exists for a method to place multiple sensors, including multiple types of sensors, at multiple points in a drill string to allow the collection of data from the multiple sensors and multiple types of sensors so as to create an accurate digital signature for individual drill strings.

SUMMARY

Embodiments usable within the scope of the present disclosure relate to downhole tools (e.g., drill bits, reamers, stabilizers, drill collars), and systems and methods for acquiring data associated with the downhole tools and/or portions of the wellbore/formation during operations (e.g., drilling). During typical use, a downhole tool, adapted for coupling to a drill string, is positioned within a wellbore for performing an operation therein, while a data acquisition module (e.g., a sensor unit or similar device having one or more sensors associated therewith) is provided in communication with the body of the downhole tool for acquiring data associated with the tool and/or a portion of the wellbore or formation proximate to the tool.

For example, a sensor unit could have components positioned at the surface of the wellbore and/or within the wellbore at a position axially separate from the downhole tool. However, in a preferred embodiment, the body of the downhole tool can include one or more recessed chambers, within which one or more data acquisition modules can be positioned (e.g., via threading the module(s) within the recessed chamber). In another embodiment, one or more data acquisition modules may be attached using suitable bolts or other means to attach to an appropriate element or appropriate elements of a drill string or downhole tool. In a further embodiment, a data acquisition module may be ring-shaped and one or more such ring-shaped data acquisition modules may be affixed to a drill string or downhole tool by compression, bolts, other attachment means or a combination thereof.

By way of example, the body of the downhole tool could include one or more blades, arms, cutters, or combinations thereof (e.g., a drill bit or reamer), and a recessed chamber for containing a data acquisition module could be positioned between two or more blades, arms, cutters, etc., or within one of the blades, cutters, or arms. Alternatively or additionally, the body of the downhole tool could include one or more gage pads (e.g., a drill bit), or one or more wear pads (e.g., a drilling stabilizer), and a recessed chamber could be positioned between two or more pads, and/or within a gage pad or wear pad. In further embodiments, the downhole tool could include a shank or similar threaded/attachment portion, and a recessed chamber for containing a data acquisition...
module could be disposed therein. In a preferred embodiment, the position of the one or more recessed chambers can be selected to minimize or prevent the reduction of the robustness of the downhole tool and/or interference with tool operation and/or to avoid weakening the body of the downhole tool, thereby compromising functionality of one or more portions of the downhole tool, or combinations thereof. By way of further example, the locations for bolt holes or other attachment means for one or more attachment points or the placement of one or more ring-shaped data acquisition modules may be determined so as to avoid or prevent the reduction of robustness or functionality of the drill string or downhole tool.

In an embodiment, the data acquisition module can be small, e.g., having at least one dimension (length, width, diameter, etc.) of 6.5 cm (2.5 inches) or less. For example, the data acquisition module could be provided with a diameter of 5.1 cm (two inches) and a length of 6.5 cm (2.5 inches) or less. Further, the data acquisition module can be designed to withstand a variety of downhole conditions, including a pressure rating of 10,300 kPa (1,500 psi) or greater and/or a temperature rating of 40 degrees Centigrade or higher. In the ring-shape, the data acquisition module can be small, although the ring-shape of such an embodiment will allow for additional storage capacity of sensors, batteries or other equipment to be placed in the ring-shaped data acquisition module. Alternatively, the ring-shape may simply be a mounting means onto which one or more data acquisition modules may be affixed, such as by a threaded, recessed chamber or using suitable bolts set into bolt holes or other attachment means in the ring-shaped mounting means.

In use, the data acquisition module can include data storage therein, and/or be in direct or remote communication with data storage that contains at least one preset value and computer instructions for instructing a processor in association with the data acquisition module to actuate one or more sensors thereof responsive to a detected condition that deviates from or exceeds the one or more preset values. For example, the sensor(s) of the data acquisition module can be actuated to begin acquiring and/or recording data responsive to a detected temperature or vibration in excess of a preset threshold value.

The data acquisition module can be configured for efficient removal and replacement thereof, such that when a drill bit or other downhole tool is removed from a wellbore, one or more data acquisition modules configured to acquire a first type of data can be interchanged with one or more data acquisition modules configured to acquire other types of data. The data acquisition module can be manufactured using high-strength plastics, such that data stored within the memory or processing unit of the sensor can be transferred to another storage means using a wireless device.

The types of sensors suitable for use within the one or more data acquisition modules are limited only by the ability to fit the sensors within the one or more data acquisition modules. For example, one or more temperature sensors can be placed in one or more data acquisition modules in one or more recessed chambers, affixed by suitable bolts or other attachment means or attached in one or more ring-shaped data acquisition modules onto or within a drill string. In another embodiment, one or more vibration sensors can be placed in one or more data acquisition modules in one or more recessed chambers, affixed by suitable bolts or other attachment means or attached in one or more ring-shaped data acquisition modules onto or within a drill string, either independently of the one or more temperature sensors of a previous embodiment or in a progression of data acquisition steps taken to acquire data from multiple types of data sensors. Types of sensors may include, but are not limited to, anti-collision sensors, sonic sensors, acoustic sensors, pressure sensors, flow sensors, hydrocarbon detection sensors, vibration sensors, and others.

Further, the one or more data acquisition units may be fitted with power generation and/or power supply means, including, but not limited to nuclear power generation units, Peltier generating devices, vibration energy cells and other energy generating or conversion devices, in addition to the one or more sensors placed within the one or more data acquisition modules.

Embodiments usable within the scope of the present disclosure thereby provide downhole tools, systems, and methods for flexibly and reliably acquiring and storing data associated with downhole tools, wellbores, and/or drilling operations that overcome the deficiencies of conventional subs, complex drill bit systems, elements that interfere with the durability and/or functionality of components, and LWD/MWD tools.

BRIEF DESCRIPTION OF THE DRAWINGS

In the detailed description of various embodiments of the present invention presented below, reference is made to the accompanying drawings, in which:

FIG. 1A depicts a perspective view of an embodiment of a data acquisition module usable within the scope of the present disclosure.

FIG. 1B depicts a side view of the data acquisition module of FIG. 1A.

FIG. 2A depicts a perspective view of an alternate embodiment of a data acquisition module usable within the scope of the present disclosure.

FIG. 2B depicts a side view of the data acquisition module of FIG. 2A.

FIG. 3A depicts a perspective view of another embodiment of a data acquisition module usable within the scope of the present disclosure.

FIG. 3B depicts a side view of the data acquisition module of FIG. 3A.

FIG. 3C depicts a cutaway view of the data acquisition module depicted in FIG. 3A, showing representative placement of sensors and other components.

FIG. 4A depicts a front view of an embodiment of a downhole tool usable within the scope of the present disclosure, having a recessed region accommodating a data acquisition module.

FIG. 4B depicts a side cross-sectional view of the downhole tool of FIG. 4A.

Embodyments of the present invention are described below with reference to the listed Figures.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Before explaining selected embodiments of the present invention in detail, it is to be understood that the present invention is not limited to the particular embodiments described herein and that the present invention can be practiced or carried out in various ways.

Embodiments usable within the scope of the present disclosure include drill bits or other drill string components
(e.g., stabilizers, reamers, underreamers, drill collars, etc.) designed or modified to accept a modular data acquisition module. As described previously, usable data acquisition modules can be designed to meet specific operational parameters to enable functionality during oil and gas drilling operations (e.g., expected pressure, temperature, and vibration) such that the drill bit or other downhole tool will not require a separate sealed chamber that maintains atmospheric pressure at a depth within a wellbore to retain the module. Typically, a drill bit or other downhole tool can simply include a recessed region into which a data acquisition module can be secured (e.g., threaded), bolt holes or other attachment means, by which the data acquisition module can be attached or a suitable other location at which the data acquisition module can otherwise be secured, such as by a ring containing one or more data acquisition modules and secured by compression.

0031] FIGS. 1A through 3B depict various, non-limiting embodiments of data acquisition modules (10A, 10B, 10C) usable within the scope of the present disclosure. Specifically, FIGS. 1A, 1B, 3A, and 3B depict data acquisition modules (10A, 10C) having a generally cylindrical body (12A) with a beveled edge (13) at an end thereof, while FIGS. 2A and 2B depict a data acquisition module having a rounded body (12B). However, it should be understood that the depicted data acquisition modules (10A, 10B, 10C) are exemplary, and that modules having any desired shape and/or dimensions can be used without departing from the scope of the present disclosure. FIGS. 1C, 2C and 3C depict various, non-limiting embodiments of cavities within the data acquisition modules (10A, 10B and 10C) within which sensors, data storage, batteries and/or power generation means may be placed.

0032] Each of the data acquisition modules (10A, 10B, 10C) is further shown having threads (14) along a partial length thereof, e.g., for engagement with complementary threads within a recessed chamber of a drill bit or other downhole tool, and a head (15), which in an embodiment, can fit closely within the recessed chamber of a downhole tool. The data acquisition modules (10A, 10B) of FIGS. 1A, 1B, 2A, and 2B are shown having a hex member (18A) disposed on the heads (16) thereof, to enable torquing and/or rotation of the data acquisition modules (10A, 10B) for engagement (or disengagement) of the depicted threads (14) with (or from) complementary threads, while the data acquisition module (10C) of FIGS. 3A and 3B is shown having a hex member (18C) with a rounded top (19), similarly able to be rotated using a tool adapted for engagement therewith.

0033] FIG. 3C depicts a cutaway side view of data acquisition module 10C. Within data acquisition module 10C is a cavity (15) into which can be placed a variety of sensors (17A, 17B or 17C) for example, as well as battery or other power generating means (11). In this example, sensor 17A is an x-axis accelerometer, sensor 17B is a y-axis accelerometer and sensor 17C is a z-axis accelerometer. Data acquisition modules 10A and 10B, as well as modules not shown in the figures, will have similar cavities for placement of sensors and other devices.

0034] Each of the data acquisition modules (10A, 10B or 10C) may be manufactured from any suitable metal or metal alloy or any suitable high-strength plastic known in the art. When the material used is a high-strength plastic, data retrieval means may include wireless methods of data retrieval which do not require the removal of the data acquisition module from the downhole tool nor the sensors from the data acquisition module. Data may be downloaded from the data acquisition module wirelessly into a computer memory or other second data storage unit.

0035] Suitable data acquisition modules can be fitted with any types of sensors as needed, including accelerometers (17A, 17B, 17C), strain gauges, temperature sensors, radiation sensors, anti-collision sensors, sonic sensors, acoustic sensors, pressure sensors, flow sensors, hydrocarbon detection sensors, vibration sensors, etc., which can be positioned internally or externally, depending on the capabilities of the sensors and/or expected characteristics of the downhole tool, the body of the module, the wellbore environment, or other similar factors. In an embodiment, the data acquisition modules can include a power source (e.g., one or more batteries (11), nuclear energy source or otherwise and/or internal data storage, and can be pre-programmed to record data only when certain detected conditions are met, reducing the amount of power used and the amount of data stored. For example, a data acquisition module can be triggered to begin recording when a certain pressure, temperature, or acceleration, or any other type of data, is detected by the sensors. In a further embodiment, power generation may be provided by a vibration energy cell or a temperature differential power generator, such as a Peltier device to power one or more sensors placed in the data acquisition module. The use of such power generators takes advantage of otherwise undesirable conditions in the borehole during drilling, such as high levels of vibration and high temperature. The use of Peltier devices includes the additional benefit of providing a cooling source for sensors in the data acquisition module.

0036] Data triggers can be preset at the surface, prior to running a downhole tool associated with the data acquisition module, eliminating the need for the sensors and other circuitry placed in the module to perform complex computations or analysis. For example, by pre-programming data triggers at the surface, a data acquisition module downhole need only compare a currently detected condition with a pre-set threshold value. As such, embodiments usable within the scope of the present disclosure enable a sensor to be designed that records data of a specific type, when certain conditions are met, and only when those certain conditions are met. This setting of surface recording triggers is possible due to the large amount of data currently existing regarding drill string, downhole tool, and drill bit performance. By pre-programming data acquisition modules at the surface, the circuitry within the data acquisition modules can be simple, thereby reducing power consumption and improving survivability and reliability under downhole conditions. Very little logic is necessary in such an embodiment, enabling the data acquisition module to be designed primarily to gather condition-specific data for later analysis. After removal of a drill bit or other downhole tool from a wellbore, a data acquisition module can be removed or downloaded and the data therein analyzed, while an additional data acquisition module, using the same type or a different type of sensor, depending on need, can be provided in the downhole tool for continued use.

0037] In an embodiment, a data acquisition module can be placed in a blind recess between the blades of a polycrystalline diamond cutter (PDC) drill bit. For example, FIG. 4A and 4B depict a PDC drill bit (20) having a body (21) with multiple blades formed thereon, of which two blades (22A, 22B) are labeled for reference, multiple jets, of which jet (24) is labeled for reference, and a shank region (25) for engagement with a drill string and/or other adjacent components.
Each blade includes multiple PDC cutting elements thereon, of which a cutter (23) is labeled for reference. The form and operation of a PDC drill bit is well known in the art, and as such, will not be described in detail.

[0038] The depicted drill bit (20) is shown having a recessed chamber (26) formed therein, between blade (22A) and blade (22B). A data acquisition module (10B), substantially similar to that shown in FIGS. 2A and 25, is shown secured within the recessed chamber (26) via threads (28) disposed at the proximal end of the recessed chamber (26). The data acquisition module (10B) can be designed to conform to the recessed chamber (26), having dimensions and threads suitable for placement therein, and can be set to record a variety of data associated with the drill bit (20), responsive to the detection of pre-selected conditions.

[0039] In an embodiment, the data acquisition module (10B) could be set to record vibration, and the pre-selected trigger threshold for initiating recording of data may be detection of a force of 5G or greater. Thus, vibration data would only be recorded once a threshold force of 5G occurs, or when the 5G threshold value or higher is breached. When combined with a timer or counter circuit data, this information can be compared to other rig operations for discrimination. It should be noted that the trigger mechanism and actuation thereof can be varied, but would be relevant to the types of sensors included in the data acquisition module (10B). It should further be understood that the threshold for data acquisition can be set prior to the use of the drill bit (20), for a very specific or very broad data regime.

[0040] While FIGS. 4A and 4B depict a drill bit, it should be understood that this is simply an exemplary use of a data acquisition module in association with a downhole tool. Embodiments of the present disclosure can include other types of tools and uses, such as a cylindrical data acquisition module (e.g., similar to those depicted in FIGS. 1A, 1B, 3A, and 3B), shaped and designed to fit into a recess within the blade of a drill string stabilizer, or within the blade of a PDC drill bit or underreamer or hole opener. Such a data acquisition module could include a temperature sensor to act as a trigger, and/or accelerometers, which type of sensors may also be set with a threshold trigger. Most oil and gas wells have an approximate temperature gradient relative to depth, thus a temperature trigger can be used to initiate recording of data only when the temperature is above or below a particular value corresponding to a desired depth. For example, lower temperature values would correspond to shallower depth while higher values would correspond to deeper conditions.

[0041] In an embodiment, a data acquisition module may be attached other than by using a recessed chamber configured in an element of a drill string or downhole tool. Other attachment means may include bolting or otherwise attachment of a data acquisition module to a suitable location on a drill string or downhole tool by means of suitable, threaded bolt holes or other attachment means placed in the element of a drill string or downhole tool.

[0042] In an embodiment, attachment of the data acquisition module may be made by use of a ring-shaped data acquisition module which is secured via compression onto a suitable location of a drill string or downhole tool. Alternatively, the attachable ring may contain one or more sites for placing one or more data acquisition modules, such as the placement of one or more recessed chambers disposed within the ring or one or more sites having bolt holes or other attachment means by which to attach one or more data acquisition modules.

[0043] In yet another embodiment, the data acquisition module can be designed into the body of an underreamer or stabilizer, such that definitive and direct data is gathered by discrete, modular data acquisition modules. This data can be similar or dissimilar, but directly related to the immediate position and function of the drill string component into which the module is affixed, as by, for example, the above—described threading means in this embodiment, the data collected is directly associated with the underreamer or stabilizer and is not inferred, such as occurs in LWD, MDW or similar data collection systems. Direct data capture allows for computer vibration models or other computer models to be tuned to match the true physical interactions between the drill string components or drill bit and the formation, creating a “system signature” for a set of downhole and/or bottom hole assembly components that can be pre-selected in the future for a particular drilling need.

[0044] In another embodiment, the data acquisition module can be designed into an expandable underreamer, allowing sensors to record data at a drilling interface away from the drill bit, produced by the underreaming tool. Such a configuration allows spatial discrimination of the effects of the underreamer drilling action, drill string components, and the drill bit drilling effects by analyzing the timing of events and the sensor data collected.

[0045] In another embodiment, a plurality of data acquisition modules can be placed in separate and discrete locations in a drill string or in a downhole tool. Placement may include close proximity between data acquisition modules, such as the placement of more than one data acquisition modules in a drill bit, for example, and in which the more than one data acquisition modules each contain different types of sensor units, such as, for example, pressure sensors, accelerometers, temperature sensors, etc. Placement of the more than one data acquisition modules in a single drill string or downhole tool may include placement of data acquisition modules in different elements of the drill string or downhole tool. For example, in such an embodiment, one data acquisition module can be placed in the drill bit, one data acquisition module can be placed in a stabilizer, with additional data acquisition modules placed in other suitable parts of a drill string or bottom hole apparatus. Where more than one data acquisition module is placed in a single drill string or downhole tool, a single type of sensor may be used such that the data of the same nature is captured across the drill string or downhole tool or different types of sensors may be used in each data acquisition module, allowing different data to be captured from the different elements of the drill string or downhole tool depending on need.

[0046] In another embodiment one or more data acquisition modules can be used with one or more sensor types in conjunction with LWD/MWD tools to aid in the assessment of the accuracy of mathematical models and inferential analyses used in the LWD/MWD tools. The real-time, multi-point data collected from the one or more data acquisition modules using one or more types of sensors can be directly compared to the real-time, single-point data collection of the LWD/MWD tools to verify the interpolation methods used in the LWD/MWD tools.

[0047] In another embodiment, the placement of one or more data acquisition modules to be used in a drill string or downhole tool may be determined by the characteristics of an individual drill string or downhole tool and/or the compo-
nents thereof and/or the need for robustness in a specific drilling application. For example, one or more data acquisition module can be used in a drill string with the specific intention of maintaining the full strength of the drill string during operation, despite the inclusion of data acquisition modules. Embodiments usable within the scope of the present disclosure thereby provide robust and flexible methods for data acquisition that are highly reliable, require minimal modification to existing downhole tool, do not significantly impact durability or performance of such tools, and can interchangeably gather a wide variety of data, triggered by desired pre-set threshold conditions.

[0048] While various embodiments of the present invention have been described with emphasis, it should be understood that within the scope of the appended claims, the present invention might be practiced other than as specifically described herein.

What is claimed is:
1. A data acquisition module comprising:
   a sensor housing or body designed to protect and house the sensor electronics and allow installation into a downhole member;
   and at least one sensor within the sensor housing or body configured to acquire local data associated with the at least one sensor relative to the location of the at least one sensor body in the drill string and in communication with a data storage means.
2. The data acquisition module of claim 1, wherein the sensor housing or body is secured within a recessed chamber designed into a downhole member such that the positioning of the recessed chamber does not interfere with tool operation or compromise functionality.
3. The data acquisition module of claim 1, wherein the sensor housing or body may be secured to a downhole member using suitable bolts or other attachment means and in which the downhole member has been fitted with threaded bolt holes or other attachment means, the position of which does not interfere with tool operation or compromise functionality.
4. The data acquisition module of claim 1, wherein the sensor housing or body may be ring-shaped, and contain one or more sensors or one or more recessed chambers or other means of attaching one or more sensors housing or bodies, and attached to the downhole member via compression and/or bolts or other attachment means and in which the position of the ring-shaped sensor housing or body does not interfere with tool operation or compromise functionality.
5. The data acquisition module of claim 1, wherein the data storage means further comprises at least one preset value and computer instructions for a processor associated with the data acquisition module to actuate the at least one sensor to acquire data responsive to a condition that deviates from the at least one preset value.
6. The data acquisition module of claim 1, wherein the data acquisition module comprises a timer and/or counter circuit, or combination thereof, for data normalization relative to operations of the drilling rig associated with the downhole sensor.
7. The data acquisition module of claim 1, wherein the at least one sensor disposed within the data acquisition module may include any type of sensor suitable for downhole applications and which can physically fit within the space available within the data acquisition module, including, but not limited to, accelerometers, strain gauges, temperature sensors, radiation sensors, anti-collision sensors, sonic sensors, acoustic sensors, pressure sensors, flow sensor, hydrocarbon detection sensors, vibration sensors, among others.
8. The data acquisition module of claim 1, wherein the data acquisition module may include power storage, power generation and/or battery storage means within the data acquisition module to provide a power source for the at least one sensor disposed within the data acquisition module.
9. The data acquisition module of claim 8, wherein the power generation means within the data acquisition module uses naturally occurring conditions, such as temperature and/or vibrations, to generate the power provided by the power generation means.
10. The data acquisition module of claim 8, wherein the power generation means uses high temperature present proximal to the data acquisition module further to provide cooling and/or temperature regulation to the at least one sensor and other electrical equipment disposed within the data acquisition module.
11. The data acquisition module of claim 1, wherein the sensor housing or body is manufactured from a high-strength plastic to allow wireless downloading of data stored within the memory of the data acquisition module.
12. A system for data acquisition during wellbore operations, the system comprising: at least one data acquisition module of claim 1, disposed within or upon a downhole member designed for coupling within a drill string and adapted to acquire data associated with the downhole member; geologic formation data proximate to the downhole member and module, environmental conditions proximal the downhole member and module, or combinations thereof.
13. The system of claim 12, wherein a plurality of sensors are disposed in a plurality of locations within a drill string, or a plurality of downhole members designed for coupling as a drill string, and adapted to acquire data relative to physical conditions of the drillstring or its location within the wellbore.
14. The system of claim 13, wherein the data collected by the multiple sensors disposed in a plurality of locations within the drill string are processed and analyzed to create a profile or digital “system signature” for the drill string.
15. A method for acquiring data associated with a specific downhole member during drilling or similar operations, the method comprising the steps of:
   providing at least one downhole sensor within a downhole member, performing an operation affecting at least one condition associated with the downhole member or its location in the wellbore; and using the at least one sensor to acquire data associated with the downhole member or its location in the wellbore.
16. The method of claim 15, wherein the step of using the at least one downhole sensor to acquire data using a processor associated with the at least one sensor to compare the at least one condition with at least one preset value and actuating the at least one sensor to acquire data responsive to a condition that deviates from the at least one preset Value.
17. The method of claim 15, wherein the data acquired by the at least one downhole sensor is used to develop a profile or digital “system signature” of behaviors of the downhole member within which it is contained, relative to the type of the downhole sensor data acquired.