Title: ARCHERY LASER TRAINING SYSTEM AND METHOD

Abstract: An archery arrow according to the present invention includes a laser transmitter disposed within the point or nock to emit a laser beam toward a target. A user may aim or propel the arrow toward the target, where the beam impacts on the target are visible to the 4 user. The bow or bow operation may be adjusted in accordance with the observed beam impact locations. Alternatively, the arrow may be employed with a laser training system including a sensing device to detect the laser beam impacts on the target and transfer the impact location information to a computer system. The computer system processes the location information and may display the arrow impact locations on the target, arrow trajectory, bow motion during aiming and other information. In addition, the computer system may determine scoring and other user performance information, and may aid in balancing the arrow.
ARCHERY LASER TRAINING SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS


In addition, the present application claims priority from U.S. Provisional Patent Application Serial No. 60/468,654, entitled “Archery Laser Training System and Method” and filed May 8, 2003. The disclosures of the aforementioned patents and patent applications are incorporated herein by reference in their entireties.

BACKGROUND OF THE INVENTION

1. Technical Field
The present invention pertains to weapon training systems, such as those disclosed in U.S. Patent Nos. 6,322,365 (Shechter et al.) and 6,616,452 (Clark et al.) and U.S. Patent Application Serial No. 10/167,750. The disclosure of U.S. Patent No. 6,322,365 (Shechter et al.) is incorporated herein by reference in its entirety. Specifically, the present invention relates to a weapon training system employing laser-emitting weapons, and, more particularly, to an archery arrow for use with an archery bow and including a laser module that emits laser pulses toward a target.

2. Discussion of the Related Art

Weapons (e.g., firearms, archery bows, etc.) are utilized for a variety of purposes, such as hunting, sporting competition, law enforcement and/or military operations. When a weapon is operated, some form of projectile is propelled from the weapon toward a target. This projectile (e.g., bullet, musket ball, shot, BB, pellet, arrow, etc.) has the capability to injure or kill. Thus, the inherent danger associated with weapons necessitates training and practice in order to minimize the risk of injury.

Various systems for training a shooter have been proposed, including those incorporating optical and laser technology. For example, U.S. Patent No. 5,281,142 (Zaenglein, Jr.) discloses a shooting simulation training device including a target projector for projecting a target image in motion across a screen, a weapon having a light projector for projecting a spot of light on the screen, a television camera and a microprocessor. An internal device lens projects the spot onto a small internal device screen that is scanned by the camera. The microprocessor receives various information to determine the location of the spot of light with respect to the target image.

International Publication No. WO 92/08093 (Kunnecke et al.) discloses a small arms target practice monitoring system including a weapon, a target, a light-beam projector mounted on the weapon and sighted to point at the target, a camera to receive the light beam reflected from the target and a processor. An evaluating unit is connected to the camera to determine the coordinates of the spot of light on the target. A processor is connected to the evaluating unit and receives the coordinate information. The processor further displays the spot on a target image on a display screen.

U.S. Patent No. 5,328,190 (Dart et al.) discloses an archery practice device that simulates dynamic targets, such as an animal hunt, on a visible screen. A video disk contains a plurality of hunting scenes which are projected via a video projector on a
vertical screen whose size simulates an area normally viewed by an archer during a hunt. The screen images are comprised of pixel areas arranged in horizontal rows and vertical columns. A source of light of a spectrum outside the humanly visible range is provided adjacent the screen. Arrows penetrating this light field reflect light to a detector sensitive to light of the spectrum, but not sensitive to visible light otherwise. The detector generates a full screen signal of a plurality of pixel areas, certain of which contain indicia of light reflection from the arrow. Upon detecting such reflection, the scene frame is frozen on the screen. The frozen frame is coordinated to the signal from the light detector, whereupon a hit zone image is projected to indicate an arrow impact point relative to the frame image to show the scoring of the point of arrow impact.

The systems described above suffer from several disadvantages. In particular, the Zaenglein, Jr. and Kunnecke et al. systems are directed toward firearm systems and, therefore, are restricted to providing training with respect to those types of weapons (e.g., these systems do not provide archery specific training). Although the Dart et al. system enables archery training, the system employs a light field proximate a target and detects light from that field reflected by arrows propelled toward the target. This detection scheme is generally restricted to determining arrow impact locations on the target and is limited with respect to tracking of the arrow and collection of information. Thus, the training potential and training applications of the Dart et al. system are limited.

OBJECTS AND SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to permit realistic archery training by employing arrows with lasers therein to enable tracking of the arrow during flight and determination of arrow impact locations on a target.

It is another object of the present invention to employ arrows with lasers therein in an archery laser training system to collect various information to enable users to adjust the archery bow configuration and/or enhance performance of archery bow operation.

Yet another object of the present invention is to assess user performance within an archery laser training system by determining scoring and/or other performance information based on detected impact locations of a laser beam emitted from an arrow.

A further object of the present invention is to employ arrows with lasers therein in a laser training system to indicate arrow trajectory during flight to a user to enable adjustment of the archery bow configuration and/or operation.
The aforesaid objects may be achieved individually and/or in combination, and it is not intended that the present invention be construed as requiring two or more of the objects to be combined unless expressly required by the claims attached hereto.

According to the present invention, an archery arrow includes a laser transmitter to emit a laser beam toward a reflective target. The laser transmitter may be disposed within the arrow point or nock. A user may aim the bow and arrow at the target or propel the arrow from the bow toward the target, where the beam impacts on the target are visible to the user to indicate the bow configuration and/or aim, or the arrow behavior or trajectory during flight. The user may adjust the bow or bow operation in accordance with the observed beam impact locations. Alternatively, the arrow may be employed with a laser training system including a sensing device to detect the laser beam impacts on the target and transfer the impact location information to a computer system. The computer system processes the location information and may display the arrow impact locations on the target, arrow trajectory, bow motion during aiming and other information via a graphical user screen. In addition, the computer system may determine scoring and other user performance information, and may aid in balancing the arrow.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of specific embodiments thereof, particularly when taken in conjunction with the accompanying drawings wherein like reference numerals in the various figures are utilized to designate like components.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view in perspective of an archery laser training system with an archery arrow directing a laser beam onto a target according to the present invention.

Fig. 2A is an exploded view in perspective and partial section of the archery arrow of Fig. 1.

Fig. 2B is a view in perspective of an exemplary laser transmitter module for use in an arrow.

Fig. 3 is an exploded view in perspective and partial section of an alternative embodiment of the archery arrow of Fig. 2A.

Fig. 4 is a view in perspective of an exemplary archery laser training system employing a sensing device to detect arrow locations according to the present invention.
Fig. 5 is a procedural flow chart illustrating the manner in which the system of Fig. 4 processes and displays laser beam impact locations according to the present invention.

Figs. 6 - 8 are schematic illustrations of exemplary graphical user screens displayed by the system of Fig. 4 during system operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The training system of the present invention includes a weapon in the form of an archery bow with an archery arrow that emits a laser pulse. An exemplary embodiment of the training system of the present invention is illustrated in Fig. 1. Specifically, the system includes an archery bow 50, a laser arrow 40 and a target 70. Bow 50 is typically a conventional archery bow and includes a bow frame 52 with a grip 53 and a bowstring 54. The bowstring is secured to each end of the bow frame. Arrow 40 is similar to a conventional archery arrow, but includes a laser transmitter to emit a laser beam 11 as described below. A user aims bow 50 at target 70 and enables arrow 40 to project laser beam 11 toward the target. The target may include any suitable indicia and may be constructed of or include a surface of any materials suitable to reflect the laser beam (e.g., in a manner visible to the user). The target reflects the beam projected from arrow 40 to indicate a simulated impact location on the target based on the bow position, thereby enabling the user to adjust the bow or bow operation accordingly. Further, the user may propel the arrow from the bow toward the target, where the motion of the beam impact on the target is visible to the user to indicate arrow behavior or trajectory during flight. The user may adjust the bow or bow operation in accordance with the observed arrow behavior. It is to be understood that the terms “top”, “bottom”, “side”, “front”, “rear”, “back”, “lower”, “upper”, “up”, “down”, “height”, “width”, “thickness”, “length”, “vertical”, “horizontal” and the like are used herein merely to describe points of reference and do not limit the present invention to any specific orientation or configuration.

An exemplary laser arrow is illustrated in Fig. 2A. Specifically, arrow 40 includes a substantially hollow shaft or body 10, a head or point 20 and a nock or tail 30. The shaft is substantially cylindrical and includes a plurality of fletchings or vanes 35 attached to and angularly disposed about the shaft toward a shaft proximal end. Fletchings 35 basically stabilize arrow 40 during flight. Nock 30 is removably secured to the proximal end of shaft 10 and includes a nock shaft member or insert 32, a stop 34 and a prong section 36. The nock insert is substantially cylindrical and disposed at the distal end of the
nock. The nock insert includes dimensions less than those of shaft 10 to enable insertion of the nock insert within the shaft for a friction fit type engagement. Stop 34 is generally circular and attached to a proximal end of nock insert 32. The stop includes dimensions greater than those of the shaft to limit insertion of the nock into the shaft. Prong section 36 is attached to a stop proximal end and includes a generally cylindrical distal portion with prongs 38 extending proximally therefrom substantially in parallel. Bowstring 54 (Fig. 1) is received between the prongs to enable projection of the arrow from the bow.

Point 20 is removably secured to the distal end of shaft 10 and includes a point shaft member or insert 22 and a tip or point member 24. The point insert is substantially cylindrical and disposed at the proximal end of the point. The point insert includes dimensions less than those of shaft 10 to enable insertion of the point insert within the shaft. Threads 19 are disposed on the point insert distal end to provide a threaded engagement with interior threads (not shown) of the shaft distal end. Tip 24 is attached to the distal end of the point insert. The tip is generally conical and is typically formed by a series of generally triangular projections or blades 26. The blades are arranged in an intersecting type fashion and adjoined along a common central axis to form the point conical configuration. A substantially cylindrical passage 28, preferably formed of a suitably rigid and substantially transparent material, is embedded within and extends longitudinally through the tip. Passage 28 is substantially centrally disposed within the tip (e.g., along the common central axis of the tip blades) and is aligned with a laser transmitter module 15 to enable the laser beam to traverse the tip as described below.

Laser transmitter module 15 is housed within point insert 22. The laser transmitter module may be similar in configuration to the laser transmitters disclosed in the aforementioned patents and patent applications, except that power switches are utilized to trigger emission of the laser beam as described below. Referring to Figs. 2A – 2B, laser module 15 includes a generally cylindrical housing 21, a power source 25, typically in the form of one or more batteries, a power switch 27, a cap 29 and an optics package 31 including a laser (not shown) and a lens 33. The cap is disposed at a proximal end of the laser module and may include a power switch 39. Power may be enabled by the power and/or cap switches in any fashion, where these switches may be implemented by any conventional or other switches to enable and disable power to the laser transmitter module. The laser transmitter module components (e.g., power source, power switch, cap, batteries, optics package, lens, etc.) may be arranged within the housing in any suitable fashion.
The laser transmitter module emits a laser pulse of visible laser light in response to
actuation of the power or cap switches. In particular, the optics package emits laser beam
11 through lens 33 and into passage 28. The tip includes one or more openings 23 defined
therein toward the tip apex or passage distal end to enable the laser beam to be projected
from the arrow toward a target. The openings may be of any shape or size and may be
defined at any suitable locations on the tip. Point 20 may be utilized with or removably
secured to (e.g., threaded engagement, friction fit, etc.) any conventional or other arrows
to enable laser beam transmission from the arrow (e.g., may replace conventional tips with
point 20, etc.).

An alternative embodiment of the laser arrow is illustrated in Fig. 3. Initially,
arrow 60 is substantially similar to arrow 40 described above, except that the laser
transmitter module is disposed in the nock. Specifically, arrow 60 includes shaft or body
10, point or head 20 and nock or tail 30. The shaft is substantially similar to the shaft
described above and includes fletchings or vanes 35 attached to and angularly disposed
about the shaft toward a shaft proximal end.

Point 20 is substantially similar to the point described above and is removably
secured to the distal end of shaft 10. The point includes point insert 22 and tip or point
member 24, each substantially similar to those described above. The point insert is
inserted within the shaft, where threads disposed on the point insert distal end provide a
threaded engagement with the shaft distal end as described above. Passage 28,
substantially similar to the passage described above, is embedded within and extends
longitudinally through the point insert and tip. Passage 28 is substantially centrally
disposed within the point insert and tip and is aligned with the laser module to enable the
laser beam to traverse the point as described below.

Nock 30 is similar to the nock described above and is removably secured to the
proximal end of shaft 10. The nock includes nock insert 32, stop 34 and prong section 36,
each substantially similar to those described above. Nock insert 32 is disposed at the nock
distal end and is inserted within the shaft for a friction fit type engagement, while stop 34
is attached to the nock insert proximal end to limit insertion of the nock insert within the
shaft as described above. Prong section 36 is attached to a stop proximal end and includes
a generally cylindrical distal portion with prongs 38 extending proximally therefrom to
receive bowstring 54 (Fig. 1) as described above.
Laser transmitter module 15 is housed within nock 30 and is substantially similar to the laser module described above (Fig. 2B), except that the laser module is actuated by a power switch disposed in prong section 36. Laser module 15 includes generally cylindrical housing 21, power source 25, typically in the form of one or more batteries, and optics package 31 including a laser (not shown) and lens 33, each as described above. The laser transmitter module is enabled by a power switch 37 disposed between prongs 38. The power switch is preferably implemented by a conventional momentary or push button type switch. Power switch 37 is typically actuated by bowstring 54 (Fig. 1) when arrow 60 is positioned on bow 50 and the bowstring is received by nock 30 between the prongs. In other words, the laser is enabled when the arrow is positioned on the bow for firing, where the bowstring actuates the power switch.

The laser transmitter module emits a laser pulse of visible laser light in response to actuation of the power switch. In particular, the optics package emits laser beam 11 through lens 33. The laser beam traverses the hollow shaft and is received in passage 28 of point insert 22. One or more openings 23 are defined in the tip as described above, where the beam traverses passage 28 through point insert 22 and tip 24 and is projected from tip openings 23 toward a target. The laser module maintains transmission of the laser pulse for a predetermined time interval, preferably two seconds, after the arrow is fired from the bow. The laser transmitter module basically emits a laser pulse continuously during actuation or closure of the switch (e.g., while the bowstring is received in the nock during aiming), and disables emission upon expiration of the predetermined time interval after the switch re-enters an open state (e.g., after release of the arrow from the bow). The laser module may include a timer and/or other circuitry to disable the laser transmission upon expiration of the time interval. In addition, the laser module or arrow may further include an audio indicator 41 that is enabled upon expiration of a predetermined time interval, preferably two seconds, after firing of the arrow (e.g., the power switch re-entering an open state as described above). The audio indicator provides a sound or noise (e.g., beep, buzz, etc.) that may assist a user in locating the arrow after firing. The indicator may be implemented by any conventional or other audio indicator and may be disposed at any suitable location within the arrow. The laser arrows described above are produced to be light and balanced, thereby enabling the laser transmitter modules to have minimal effect on the arrow flight or trajectory.
Operation of the archery training system is described with reference to Figs. 1, 2A – 2B and 3. Specifically, arrow 40 or 60 is placed on bow 50 with bowstring 54 received in nock 30 between prongs 38 as described above. The laser transmitter module may be enabled via power switches 27, 37 or 39 depending upon the particular arrow utilized (e.g., power switches 27 or 39 for arrow 40, power switch 37 for arrow 60, etc.). The bow and arrow are aimed at target 70, where the projected laser beam is visible to a user to indicate a simulated projectile impact location. The laser beam is especially useful for night time activities to illuminate intended targets. The user may adjust bow position or operation according to the indicated impact location. For example, the laser beam reflection on the target may be utilized to adjust sights on the bow. The sights may be adjusted or zeroed for alignment with the laser beam impact location. If a user desires to fire the arrow, the laser beam positions may be observed or monitored on target 70, thereby providing an indication of the arrow behavior or trajectory during flight. The user may adjust the bow or bow operation in accordance with the observed arrow behavior.

An archery laser training system that detects simulated impact locations according to the present invention is illustrated in Fig. 4. Specifically, the system includes bow 50, a sensing device 80, a computer system 44 and target 70. The bow may be utilized with laser arrow 40 or 60 to propel the laser arrow toward target 70. The bow, laser arrows and target are substantially similar to those described above. A user aims bow 50 at target 70 and operates the bow in order to propel the laser arrow toward the target. The laser arrow projects laser beam 11 toward the target during aiming of the bow and arrow flight. The sensing device detects the laser beam impact on the target and transfers the impact location information to computer system 44. The computer system processes the location information and may display the arrow impact location on the target, arrow trajectory, bow motion during aiming and other information via graphical user screens (Figs. 6 - 8) as described below. In addition, the computer system may determine scoring and other user performance information, and may aid in balancing an arrow as described below.

Computer system 44 is coupled to and receives and processes information from sensing device 80 to provide various feedback to a user. The computer system is typically implemented by a conventional IBM-compatible or other type of personal computer (e.g., laptop, notebook, desk top, mini-tower, Apple MacIntosh, palm pilot, etc.) preferably equipped with a base 45 (e.g., including the processor, memories, and internal or external communication devices or modems), a display or monitor 47, a keyboard 48 and an
optional mouse or other input devices (not shown). The computer system preferably utilizes a Windows platform, however, any of the major platforms (e.g., Linux, Macintosh, Unix, OS2, etc.) may be employed. Further, the system includes components (e.g., a processor, disk storage or hard drive, etc.) having sufficient processing and storage capabilities to effectively execute the software for the training system. The software is typically in the form of a Windows application.

The manners of collecting and processing target impact information are similar to those described in aforementioned U.S. Patent No. 6,616,452 (Clark et al.) and/or U.S. Patent Application Serial No. 10/167,750. In particular, sensing device 80 is preferably connected to a Universal Serial Bus (USB) port of computer system 44 via a cable 82. The sensing device may alternatively be connected to an Ethernet port or card of computer system 44 or to any suitable type of computer system port (e.g., serial, parallel, USB, Ethernet, etc.). The sensing device is typically implemented by a sensory image type camera employing charge-coupled devices (CCD) or CMOS and is disposed in proximity of target 70. The sensing device may be mounted on a tripod or other stand (not shown) and may alternatively be implemented by any type of light or image sensing device. The sensing device typically has a sufficient speed or rate to repeatedly capture an image of the target and provide target image information to the computer system. In other words, an image of the target is captured by the sensing device and provided to the computer system within a frame at the device frame rate (e.g., a quantity of frames per second).

Alternatively, the sensing device may detect the location of beam impacts on the target (e.g., by capturing an image of the target or of impact locations and determining the location of the beam impact from the captured image) and include a signal processor and associated circuitry to provide impact location information in the form of X and Y coordinates to computer system 44 for processing in substantially the same manner described in aforementioned U.S. Patent No. 6,616,452 (Clark et al.) and/or U.S. Patent Application Serial No. 10/167,750.

The image characteristics of the sensing device enable the device to capture images of the target including any changes to the target (e.g., beam impacts, etc.) occurring between successive frame transmissions. The computer system may measure the arrow flight time based on the quantity of succeeding frames containing a laser beam impact (e.g., by multiplying the quantity of frames including a beam impact by the rate or time of a single sensing device frame, or by dividing the quantity of beam impact frames by the
quantity of frames per second of the sensing device). The system may further determine other parameters based on the measured arrow flight time (e.g., velocity for a particular target distance, distance to the target for a particular arrow velocity, etc.). Calibrations are further performed by the system to align the sensing device and target, to define the target within the captured target images and to adjust for ambient light conditions in substantially the same manners described in aforementioned U.S. Patent No. 6,616,452 (Clark et al.) and/or U.S. Patent Application Serial No. 10/167,750. A printer (not shown) may further be connected to the computer system to print reports containing user feedback information (e.g., score, hit/miss information, bow motion during operation, arrow flight trajectory, etc.), while information from training sessions may be stored.

The system may be utilized with various types of targets. Target characteristics are contained in several files that are stored by computer system 44. In particular, a desired target may be photographed and/or scanned prior to system utilization to produce several target files and target information. Alternatively, images of user generated targets may be captured via sensing device 80 and optionally manipulated to form a target image, while computer system 44 or other computer system (e.g., via training system or conventional software) may be utilized to produce the target files and target information for use by the system.

A target file may include a parameter file, a display image file, a scoring image file and a print image file. The parameter file includes information to enable the computer system to control system operation. By way of example only, the parameter file includes the filenames of the display, scoring and print image files, a scoring factor and cursor information. The display and print image files include an image of the target scaled to particular sections of the monitor and report containing that image, respectively. Indicia, preferably in the form of substantially circular icons, are overlaid on these images (e.g., Fig. 6) to indicate beam impact locations, and typically include an identifier to indicate the particular shot (e.g., the position number of the shot within a shot sequence). The scoring image file includes a scaled scoring image of the target having scoring sections or zones shaded with different colors. Any variation of colors may be utilized, and the colors are each associated with corresponding information associated with that zone. The zone information typically includes scoring values, but may include any other types of activity information (e.g., target number, desirable/undesirable hit location, priority of hit location, etc.). When impact location information is received from the sensing device, computer
system 44 translates that information to coordinates within the scoring image. The color
associated with the image location identified by the translated coordinates indicates a
corresponding zone and/or scoring value. In effect, the colored scoring image functions as
a look-up table to provide a zone value based on coordinates within the scoring image
pertaining to a particular beam impact location. The scoring value of an impact location
may be multiplied by a scoring factor within the parameter file to provide scores
compatible with various scoring schemes. Thus, the scoring of the system may be
adjusted by modifying the scoring factor within the parameter file and/or the scoring zones
on the scoring image within the scoring image file. Alternatively, when other activity
information is associated with the zones, the scoring image file may indicate occurrence of
various events (e.g., hit/miss of target locations, target sections impacted based on priority,
etc.) in substantially the same manner described above.

In addition, the target files typically include a second display file containing a
scaled image of the target. The dimensions of this image are substantially greater than
those of the image contained in the initial display image file, and the second display file is
preferably utilized to display a target having plural independent target sites. The target
files along with scaling and other information (e.g., target range information entered by a
user, etc.) are stored on computer system 44 for use during system operation. An initial
calibration is performed to correlate the target with the sensing device and computer
system. Thus, the system may readily accommodate any type of target without
interchanging system components. Moreover, target files may be downloaded from a
network, such as the Internet, and loaded into the computer system to enable the system to
access and be utilized with additional targets.

Computer system 44 includes software to control system operation and provide a
graphical user interface for displaying user performance. The manner in which the
computer system monitors beam impact locations and provides information to a user is
illustrated in Figs. 5 - 8. Initially, computer system 44 (Fig. 4) performs calibrations at
step 140. Basically, the computer system may perform various calibrations (e.g., to align
the sensing device with the target and computer system, to define the target within the
captured target images, to adjust for ambient light conditions, to determine parameters for
system operation, etc.), such as those described in aforementioned U.S. Patent No.
6,616,452 (Clark et al.) and/or U.S. Patent Application Serial No. 10/167,750.
Once the calibrations are completed, a user may commence projecting the laser beam and/or arrow toward the target. Sensing device 80 captures target images at step 142, and transmits the captured target images to computer system 44 for processing at step 144. The computer system processes the captured target images in manners similar to those described in aforementioned U.S. Patent No. 6,616,452 (Clark et al.) and/or U.S. Patent Application Serial No. 10/167,750 to determine a beam impact location at step 146. Specifically, each captured target image received from the sensing device includes a plurality of pixels each associated with red (R), green (G) and blue (B) values to indicate the color and luminance of that pixel. The red, green and blue values for each pixel are multiplied by a respective weighting factor and summed to produce a pixel density as follows:

\[ \text{Pixel Density} = (R \times \text{Weight1}) + (G \times \text{Weight2}) + (B \times \text{Weight3}) \]

where Weight1, Weight2 and Weight3 are weighting values that may be selected in any fashion to enable the system to identify beam impact locations within the captured target images. The respective weights may have the same or different values and may be any types of values (e.g., integer, real, etc.).

A beam impact is considered to occur within a pixel group of a captured target image where each group member has a density value exceeding a threshold. The pixel group forms an area or shape where the center pixel of that area or shape is considered by the system to contain, or represent the location of, the beam impact. If the density value of each captured image pixel is less than the threshold, the captured target image is not considered to include a beam impact. When the computer system identifies a pixel containing a beam impact, the coordinates (e.g., X and Y coordinates) of that pixel within the captured target image are determined by the computer system. These coordinates represent the location of a beam impact within the captured target image. Since the laser arrow continuously transmits the laser beam, several beam impact locations are identified by the computer system during aiming of the bow and flight of the arrow. Each location is saved in order to track bow motion and the arrow flight or trajectory as described below. The last impact location identified by the computer system in a series of images is considered to be the location of the projectile impact (e.g., the last location the arrow projected the laser beam onto the target).
The computer system includes several target files having target information and scaled images as described above. Since the scaling of the scoring and display images are predetermined, the computer system translates the resulting processed or converted coordinates into the respective scoring and display image coordinate spaces at step 148. Basically, the scoring and display images each utilize a particular quantity of pixels for a given measurement unit (e.g., millimeter, centimeter, etc.). The ratios of the pixel quantities between the target and each of the scoring and display images are determined and applied to the processed or converted coordinates to produce translated coordinates within each of the respective scoring and display image coordinate spaces. Each impact location is translated for the display image to enable display of the bow or arrow motion, while typically only the projectile impact location is translated for the scoring image to determine a score.

In addition, the computer system may determine the arrow flight time based on the quantity of succeeding frames containing a laser beam impact (e.g., by multiplying the quantity of frames including a beam impact by the rate or time of a single sensing device frame, or by dividing the quantity of beam impact frames by the quantity of frames per second of the sensing device) and other parameters based on the measured arrow flight time (e.g., velocity for a particular target distance, distance to the target for a particular arrow velocity, etc.) as described above.

The translated coordinates for the scoring image are utilized to determine the score or other activity information for the beam impact at step 150. Specifically, the translated coordinates identify a particular location within the scoring image. Various sections of the scoring image are color coded to indicate a value or other activity information associated with that section as described above. The color of the location within the scoring image identified by the translated coordinates is ascertained to indicate the value or other activity information for the beam impact. The scoring factor within the parameter file is applied to (e.g., multiplied by) the score value to determine a score for the beam impact. The score and other impact information is determined and stored in a database or other storage structure, while a computer system display showing the target is updated to illustrate the beam impact location and other information at step 152. The display image is displayed, while the beam impact location is identified by indicia that are overlaid with the display image and placed in an area encompassing the translated display image coordinates.
Exemplary graphical user screens indicating the target, beam impact locations and other
information are illustrated in Figs. 6 - 8.

If a round or session of activity is not complete as determined at step 154, the user
continues to actuate the bow and fire arrows and the system detects beam impact locations
and determines information as described above. However, when a round or session is
determined to be complete at step 154, the computer system retrieves information from the
database and determines information pertaining to the round at step 156.

When a report is desired as determined at step 158, the computer system retrieves
the appropriate information from the database and generates a report for printing at step
160. The report includes the print image, while beam impact location coordinates are
retrieved from the database and translated to the print image coordinate space. The
translation is accomplished utilizing ratios of pixel quantities for a given measurement unit
between the target and the print image in substantially the same manner described above.
The beam impact locations are identified by indicia that are overlaid with the print image
and placed in an area encompassing the translated print image coordinates as described
above for the display. The report may further include various information pertaining to
user performance. When another round is desired, and a calibration is requested at step
164, the computer system performs the calibrations at step 140 and the above process of
system operation is repeated. Similarly, the above process of system operation is repeated
from step 142 when another round is desired without performing a calibration. System
operation terminates upon completion of the training activity as determined at step 162.

The system may provide a tracking feature to measure bow motion during
operation and/or arrow flight or trajectory. Basically, the laser arrow continuously emits a
laser beam during bow operation and flight of the arrow toward the target. The computer
system determines and saves coordinates of laser beam impact locations from target image
information received from the sensing device and translates those coordinates to display
image coordinates as described above. The beam impact locations are displayed on the
display in accordance with the translated coordinates. As the bow or arrow alters position,
the impact locations are similarly added on the display to visually indicate movement of
the bow or arrow. The adjusted impact locations may be indicated by a continuous line
extending between successive locations to graphically illustrate bow motion or arrow
trajectory (e.g., as illustrated in Figs. 7 – 8). Alternatively, the system may process the
impact location coordinates and display the bow motion or arrow trajectory in any fashion
(e.g., graphically, numeric data, charts, etc.).

The system may provide an arrow balancing feature to measure arrow flight or
trajectory and provide information to a user to balance the arrow. Basically, the laser
arrow (or other arrow employing the laser emitting point or nock described above)
continuously emits a laser beam during flight of the arrow toward the target. The
computer system determines and saves coordinates of laser beam impact locations from
target image information received from the sensing device and translates those coordinates
to display image coordinates as described above. An unbalanced arrow typically produces
an erratic or jerky trajectory which may be detected and/or recorded by the system via a
sensing device with a rapid frame rate (e.g., approximately 2,000 frames per second). The
beam impact locations are displayed on the display in accordance with the translated
coordinates. As the arrow alters position, the impact locations are similarly added on the
display to visually indicate movement of the arrow. The adjusted impact locations may be
indicated by a continuous line extending between successive locations to graphically
illustrate arrow trajectory. Alternatively, the system may process the impact location
coordinates and display the arrow trajectory in any fashion (e.g., graphically, numeric
data, charts, etc.). The computer system may analyze the trajectory or impact locations
and provide any information to a user relating to arrow balancing adjustments (e.g.,
addition or removal of weight from particular arrow locations, adjustment of arrow
component positions, etc.) in order to balance the arrow.

Operation of the system is described with reference to Fig. 4. Initially, target 70 is
positioned with sensing device 80 disposed proximate the target and connected to the
computer system via cable 82. System software and/or target files are installed on
computer system 44 as described above (e.g., if the software is not currently resident on
the computer system or a new target is being utilized). Laser arrow 40 or 60 is placed on
bow 50 for emission of the laser beam. The computer system is commanded to commence
an activity, and initially performs calibrations. Once the calibrations are complete, the
bow may be actuated by a user, while the sensing device captures images of the target and
provides target image information to the computer system as described above. The
computer system determines the coordinates of beam impact locations within the target
from the received captured target images as described above and translates those
coordinates into the respective scoring and display image spaces. The computer system
further determines a score value corresponding to the impacted target section and other
information for storage in a database as described above. The impact location and other
information are displayed on graphical user screens (Figs. 6 - 8) as described above.
When a round is complete, the computer system retrieves the stored information and
determines information pertaining to the round for display on the graphical user screen.
Moreover, a report may be printed providing information relating to user performance as
described above. In addition, the system may provide indicia on the display to indicate
and trace bow movement and arrow flight or trajectory (Figs. 7 –8) as described above.

Laser arrows 40, 60 described above may further include retroreflective material
43 (Figs. 2A and 3) disposed on the nock. This material assists the user in locating arrows
after firing. The sensing device may be disposed at any orientation relative to the target or
arrow trajectory. Thus, the sensing device may track the arrow from the rear (e.g., via the
retroreflective material), side or front in a manner similar to that described above. Further,
the sensing device and computer system may be utilized to determine the time of flight of
the arrow (e.g., by multiplying the quantity of frames including a beam impact by the rate
or time of a single sensing device frame, or by dividing the quantity of beam impact
frames by the quantity of frames per second of the sensing device) and other parameters as
described above and for automatic zeroing of a bow sight. For example, a user may direct
the laser arrow beam at a reference site on the target based on the bow sight. The sensing
device detects the beam and transfers information to the computer system as described
above. The computer system may determine the offset between the beam and reference
site and indicate to the user the amount of adjustment for the bow sight. Alternatively, the
user may adjust the bow sight until the computer system indicates the beam is impacting
the reference site, thereby indicating proper zeroing of the bow sight. In addition, the laser
arrows may be utilized as sights to illuminate a target with the laser beam prior to firing
the arrow. This is especially useful for night time activities (e.g., training, hunting, etc.) or
for conditions with limited lighting.

It will be appreciated that the embodiments described above and illustrated in the
drawings represent only a few of the many ways of implementing an archery laser training
system and method.

The laser training systems may be utilized with any type of weapon (e.g.,
propelling an arrow or similar projectile, etc.). Further, the systems may include a dummy
weapon or projectile projecting a laser beam for training. The bow may be implemented
by any type of conventional or other bow with any suitable accessories.

The laser module may emit any type of laser beam. The laser module housing may
be of any shape or size, and may be constructed of any suitable materials. The optics
package may include any suitable lens for projecting the beam. The laser beam may be
enabled for any desired duration sufficient to enable a user to view the reflection from the
target or to enable the sensing device to detect the beam. The laser module may be
fastened to or disposed within a projectile or other similar structure at any suitable
locations and be actuated by weapon actuation or any device (e.g., power switch,
bowstring, relay, etc.). The laser module may include any type of sensor or detector (e.g.,
auditory sensor, piezoelectric element, accelerometer, solid state sensors, strain gauge,
etc.) to detect mechanical or acoustical waves or other conditions signifying weapon
actuation. The laser module components may be arranged within the housing in any
fashion, while the module power source may be implemented by any type of batteries or
other power source. The laser beam may be visible or invisible (e.g., infrared), may be of
any color or power level, may be modulated in any fashion (e.g., at any desired frequency
or unmodulated) or encoded in any manner to provide any desired information and may
project the beam continuously (e.g., a "constant on" mode) or in the form of a pulse of any
desired duration. The system may be utilized with transmitters and detectors emitting and
detecting any type of energy (e.g., light, infrared, etc.).

The computer system may be implemented by any conventional or other computer
or processing system. The components of the system may be connected by any
communications devices (e.g., cables, wireless, network, etc.) in any desired fashion, and
may utilize any type of conventional or other interface scheme or protocol. The computer
system may be in communication with any quantity of other training systems via any type
of communications medium (e.g., direct line, telephone line/modem, network, LAN,
WAN, Internet, etc.) and may transfer any desired information to facilitate group training
or competitions. Further, the group training or competitions may be facilitated via
transfer of information through central network hosts or server systems (e.g., web sites on
the Internet, etc.) in communication with the training systems. The computer system may
include any type of printing device, display and/or user interface to provide any desired
information relating to a user session. The system may be configured for any types of
training, qualification, competition, gaming and/or entertainment applications. The printer may be implemented by any conventional or other type of printer.

It is to be understood that the software for the computer system may be implemented in any desired computer language and could be developed by one of ordinary skill in the computer arts based on the functional description contained in the specification and flow chart illustrated in the drawings. The computer system may alternatively be implemented by any type of hardware and/or other processing circuitry. The various functions of the computer system may be distributed in any manner among any quantity of software modules, processing systems and/or circuitry. The software described above may be modified in any manner that accomplishes the functions described herein.

The display screens and reports may be arranged in any fashion and contain any type of information. The system may produce any desired type of display or report having any desired information. The system may be utilized to measure arrow flight time or other desired parameters (e.g., projectile velocity, target range, time between shots, etc.) and/or track bow motion and/or arrow trajectory. The computer system may analyze the motion and/or trajectories and provide any desired information to adjust the bow, bow operation or arrow (e.g., inform a user to adjust bow position, inform a user to adjust bow accessories, inform a user of adjustments to balance an arrow, etc.). The computer system may determine scores or other activity information based on any desired criteria. The system may be utilized with targets scaled in any fashion to simulate conditions at any desired ranges, and may utilize lasers having sufficient power to be detected at any desired scaled range. For example, the system may be used for extended range targets in substantially the same manner described in aforementioned U.S. Patent Application Serial No. 10/167,750.

The systems may include any quantity or type of target of any shape or size, constructed of any suitably reflective materials and placed in any desired location. The targets may be implemented by any type of target (e.g., any type of target indicia on a substrate (e.g., paper, metal, plastic, etc.)) having any desired configuration and indicia forming any desired target site (e.g., bull’s eye (e.g., Figs. 6 – 7), silhouette, animal (e.g., Fig. 8), etc.). The targets may be of any shape or size, and may be constructed of any suitable materials. The targets may include any conventional or other fastening devices to attach to any supporting structure. Similarly, the supporting structure may include any conventional or other fastening devices to secure a target to that structure. Alternatively,
any type of adhesive may be utilized to secure a target to the structure. Moreover, the
systems may present video/graphic target scenarios (e.g., still, moving, etc.) on a wall,
screen or other structure via connection to one or more digital video projection systems.
Examples of such projection systems include products by Sony, Proximal, and Panasonic.
The projected video targets may be associated with several target files containing target
characteristics to determine impact locations relative to intended target sites and various
information (e.g., scoring, performance, etc.).

The targets may include any quantity of sections or zones of any shape or size and
associated with any desired values. The targets may include any quantity of individual
targets or target sites. The system may utilize any type of coding, color or other scheme to
associate values with target sections (e.g., table look-up, target location identifiers as keys
into a database or other storage structure, etc.). Further, the sections or zones may be
identified by any type of codes, such as alphanumeric characters, numerals, etc., that
indicate a score value or any other information. The score values may be set to any
desired values.

The target characteristics and images may be contained in any quantity of any
types of files. The target images may be scaled in any desired fashion. The coordinate
translations may be accomplished via any conventional or other techniques, and may be
performed by the sensing device and/or computer system. The target files may contain
any information pertaining to the target (e.g., filenames, images, scaling information,
indicia size, etc.). The target files may be produced by the computer system or other
processing system via any conventional or other software and placed on the computer
system for operation. Alternatively, the target files may reside on another processing
system accessible to the computer system via any conventional or other communications
medium (e.g., network, modem/telephone line, etc.), or be available on any type of storage
medium. The system may utilize any conventional or other techniques to convert between
the various image spaces, and may compensate for any desired sensing device position
and/or viewing angle.

The targets may alternatively be implemented by laser detecting devices, such as
those described in aforementioned U.S. Patent No. 6,322,365 (Shechter et al.). In this
case, the target preferably includes a suitably rigid shield to protect the target from the
projectile, while enabling the laser beam to traverse the shield and impact the laser
detecting target.
The sensing device may be implemented by any conventional or other sensing device (e.g., camera, CCD, matrix or array of light sensing elements, etc.) suitable for detecting the laser beam and/or capturing a target image. The sensing device may employ any type of light sensing elements, and may utilize a grid or array of any suitable dimension. The sensing device may be of any shape or size, and may be constructed of any suitable materials. The sensing device may be supported by any mounting device (e.g., a tripod, a mounting post, etc.) and positioned at any suitable locations providing access to the target. The sensing device may be coupled to any port (e.g., serial, parallel, USB, Ethernet, etc.) of the computer system via any conventional or other device (e.g., cable, wireless, etc.). The sensing device may provide color or black and white (e.g., gray scale) images to the computer system and have any desired frame rate. Alternatively, the sensing device may include processing circuitry to detect beam impact locations and provide coordinates of those locations to the computer system.

Further, the sensing device may be implemented by an image capture device that may include a removable filter. The image capture device may be utilized without the filter to capture and produce an image of a desired target. The image capture device initially captures a target image and modifies the image to correct for geometrical offsets, optics and lighting variances, and performs other image enhancement techniques. The enhanced image is provided to the computer system for display, and corresponds with increased accuracy to the target. Scaling and other information is also provided to or by the computer system to facilitate translations of received beam impact location coordinates and scoring as described above, thereby minimizing calibration.

Moreover, the filter (e.g., an approximate 650 nanometer bandpass filter) may be placed over the image capture device to filter incoming light signals and to enable the device to detect laser beam impact locations in response to the arrow laser beam. The image capture device provides X and Y coordinates or other location information to the computer system to display the impact location and determine scoring and other information as described above.

The sensing device may be configured to detect any energy medium having any modulation, pulse or frequency. Similarly, the laser may be implemented by a transmitter emitting any suitable energy wave. The sensing device may transmit any type of information to the computer system to indicate beam impact locations, while the computer system may process any type of information (e.g., X and Y coordinates, image
information, etc.) from the sensing device to display and provide feedback information to
the user (e.g., user performance information, arrow balancing adjustments, bow
adjustments, technique information, etc.).

The density value may be determined with any weights having any desired value or
types of values (e.g., integer, real, etc.). The weights and pixel component values may be
utilized in any desired combination to produce a pixel density. Alternatively, any quantity
of pixel values within any quantity of images may be manipulated in any desired fashion
(e.g., accumulated, averaged, multiplied by each other or weight values, etc.) to determine
the presence and location of a beam impact within an image. The threshold may be set by
the computer system and/or user to any desired value based on any desired conditions
(e.g., ambient light, etc.). The systems may alternatively utilize gray scale or any type of
color images (e.g., pixels having gray scale, RGB or other values) and manipulate any
quantity of pixel values within any quantity of images in any desired fashion to determine
the location of a beam impact.

The indicia indicating beam impact locations and other information may be of any
quantity, shape, size or color and may include any type of information. The indicia may
be placed at any locations and be incorporated into or overlaid with the target images. The
computer system may poll the sensing device or the sensing device may transmit images
and/or coordinates at any desired intervals for sensing functions.

The laser module may be disposed at any locations or within any components of
the arrow (e.g., point, shaft, nock, etc.) or other similar projectile (e.g., spear, javelin, dart,
football, etc.). The arrows and corresponding components (e.g., point, shaft, nock, etc.)
may be of any quantity, shape or size and may be constructed of any suitable materials
(e.g., plastic, aluminum, graphite, etc.). The arrow components (e.g., point, shaft, nock,
etc.) may be solid or at least partially hollow. The nock and point components (e.g., point
insert, nock insert, stop, prong section, tip, etc.) may be attached or secured together via
any conventional or other techniques (e.g., welded, adhered, fasteners, formed integral,
etc.) to form the nock and point, respectively. The shaft may include any quantity of
fletchings of any shape or size disposed on or about the shaft in any desired fashion. The
fletchings may be permanently or removably secured to the shaft via any conventional or
other securing techniques.

The point may be removably or permanently secured to the shaft via any
conventional or other securing techniques (e.g., friction fit, threaded engagement, integral
with, etc.). The tip may be of any shape or size, and may be constructed of a single
formed structure or any quantity of projections or blades of any shape or size and arranged
in any fashion. The point insert may be of any shape or size for engagement with the
shaft. The point insert and/or tip may house a laser module to emit a laser beam from the
arrow. The passage may be of any shape or size and may be disposed in the tip and/or
point insert in any desired fashion. The passage may be constructed of any suitable
materials and have any degree of transparency (e.g., transparent, translucent, opaque, etc.).
The tip openings may be of any quantity, shape or size and may be disposed at any
locations on the point to enable the laser beam to be projected from the arrow. The
passage may be disposed in (and/or traverse) the arrow and/or arrow components (e.g.,
point, shaft, nock, etc.) in any fashion to provide a path within any portion of the arrow for
the laser beam.

The nock may be removably or permanently secured to the shaft via any
conventional or other securing techniques (e.g., friction fit, threaded engagement, integral
with, etc.). The stop and prong section may be of any shape or size. The prongs may be
oriented at any desired angle suitable to receive the bow string. The nock insert may be of
any shape or size for engagement with the shaft. The nock insert, stop and/or prong
section may house a laser module to emit a laser beam from the arrow. The arrow
components (e.g., point, shaft, nock, etc.) housing the laser module may be configured to
be interchangeable with corresponding conventional arrow components to enable
conventional arrows to project laser beams as described above.

The laser module may include any quantity of any type of conventional or other
power switch (e.g., push button, on/off, momentary, etc.). The power switch may be
disposed within the laser module or remotely from the module at any location on the arrow
or other projectile. The switch and/or laser module may be associated with any
conventional or other circuitry (e.g., timers, etc.) to enable the laser module for any
desired time interval. The interval may commence in response to any condition (e.g.,
firing of the projectile, actuation of the switch, etc.). The laser module components (e.g.,
cap, power switch, optics package, lens, housing, power source, etc.) may be of any
quantity, shape or size, may be constructed of any suitable materials and may be
implemented by any conventional or other components for projecting a laser beam.

The arrows may further include any quantity of any conventional or other
indicators (e.g., audio, beep, visual or light, flashing, etc.) disposed at any locations to
assist in locating an arrow. The indicators may be enabled for any desired time interval
and at any desired time (e.g., any time interval after firing, etc.). The arrows may further
include any quantity of reflective or retroreflective material of any shape or size disposed
at any suitable locations on the arrows. The material may assist a user in locating an
arrow or aid a sensing device to track the arrow from any desired view or angle. Further,
the laser arrows may be configured for training purposes (e.g., with a sharp or blunt tip to
penetrate or be reflected from a target, etc.) or for actual use in various activities (e.g., to
penetrate training or other targets, hunting, etc.).

The computer system may analyze beam impacts, the bow motion and/or arrow
trajectory and provide any feedback or instructional information to a user (e.g., scoring,
evaluation of performance against particular criteria, information to zero sights,
information to balance the arrow, information to adjust bow accessories, information to
adjust bow position, information to adjust shooting technique, etc.).

The present invention is not limited to the applications disclosed herein, but may
be applied to any other types of similar weapons, projectiles or objects (e.g., cross-bows,
spears, darts, javelins, footballs, etc.) for training or other purposes.

From the foregoing description, it will be appreciated that the invention makes
available a novel archery laser training system and method, wherein an archery arrow
includes a laser transmitter therein to project a laser beam onto a target and enable a user
to adjust the bow configuration and/or operation in accordance with the beam impact
location.

Having described preferred embodiments of a new and improved archery laser
training system and method, it is believed that other modifications, variations and changes
will be suggested to those skilled in the art in view of the teachings set forth herein. It is
therefore to be understood that all such variations, modifications and changes are believed
to fall within the scope of the present invention as defined by the appended claims.
What is Claimed is:

1. An archery training system to enable a user to adjust a bow configuration and to enhance bow operation comprising:
   an arrow including a body member, a point member disposed at a first end of said body member, a nock member disposed at a second end of said body member and a transmitter module to transmit energy signals during at least one of aiming and flight of said arrow.

2. The system of claim 1, wherein said point member includes a passage defined therein to enable said energy signals to traverse said point member.

3. The system of claim 2, wherein said point member further includes at least one opening coupled to said passage to enable said energy signals to be emitted from said arrow.

4. The system of claim 1, wherein said transmitter module includes a laser module to transmit a laser signal.

5. The system of claim 4, wherein said laser module is disposed within said point member.

6. The system of claim 5, wherein said point member is interchangeable with points of other arrows.

7. The system of claim 5, wherein said point member includes a point insert for insertion within said body member and a tip disposed at a point insert distal end, and wherein said laser module is disposed within said point insert.

8. The system of claim 5, wherein said laser module includes a power switch to activate emission of said laser signal.
9. The system of claim 8, wherein said laser module includes a housing with a cap disposed at a housing distal end, and wherein said power switch is disposed on said cap.

10. The system of claim 4, wherein said laser module is disposed within said nock member.

11. The system of claim 10, wherein said nock member includes a plurality of prongs disposed at a nock member proximal end to receive a string of said bow, and wherein said laser module includes a power switch disposed between said prongs to activate emission of said laser signal in response to reception of said bow string between said prongs.

12. The system of claim 10, wherein said laser module includes a timer to disable emission of said laser signal in response to expiration of a predetermined time interval after propelling said arrow from said bow.

13. The system of claim 1, wherein said arrow further includes an audio indicator to emit audio signals to identify a location of said arrow.

14. The system of claim 1, wherein said arrow includes at least one of reflective material and retroreflective material disposed thereon.

15. The system of claim 4, wherein said laser module illuminates intended target sites during said aiming of said arrow.

16. The system of claim 4 further including:
a target to receive and reflect said laser signal to indicate laser signal impact locations on said target, wherein at least one of configuration and operation of said bow is adjusted in accordance with said impact locations.

17. The system of claim 16, wherein at least one of a sight of said bow, balance of said arrow, and aim of said arrow is adjusted in accordance with said impact locations.
18. The system of claim 16 further including:
a sensing device to detect said impact locations on said target; and
a processor to receive from said sensing device information associated with said
impact locations detected by said sensing device, wherein said processor includes an
evaluation module to process and evaluate said received information and to display
information relating to said evaluation and an image of said target with indicia indicating
said detected impact locations on said target.

19. The system of claim 18, wherein said impact location information includes
coordinates of detected impact locations.

20. The system of claim 18, wherein said impact location information includes
captured images of said target including said impact locations, and said evaluation module
includes a coordinate module to determine coordinates of detected impact locations within
said captured target images.

21. The system of claim 18, wherein said evaluation module includes a scoring
module to determine a score for a user by accumulating score values of target locations
impacted by said laser signal.

22. The system of claim 18, wherein said sensing device includes a camera.

23. The system of claim 18, wherein said evaluation module includes a
parameter module to determine parameters relating to at least one of a time of flight of
said arrow to said target and zeroing a sight of said bow.

24. The system of claim 18, wherein said evaluation modules includes a track
module to track movement of said arrow based on said impact location information.

25. The system of claim 24, wherein said evaluation module further includes a
trajectory module to analyze said tracked movement of said arrow and provide
information relating to balancing said arrow.
26. An archery training system to enable a user to adjust a bow configuration and enhance bow operation comprising:
   an interchangeable point member for an arrow including a point insert for insertion within an arrow shaft and a tip disposed at a point insert distal end, wherein a laser module is disposed within said point member to transmit a laser signal during at least one of aiming and flight of said arrow.

27. The system of claim 26, wherein said point member includes a passage defined therein to enable said laser signal to traverse said point member and at least one opening coupled to said passage to enable said laser signal to be emitted from said point member.

28. A method of adjusting a bow configuration and enhancing bow operation via an archery training system comprising:
   (a) transmitting energy signals from an arrow toward a target during at least one of aiming and flight of said arrow, wherein said arrow includes a body member, a point member disposed at a first end of said body member, a nock member disposed at a second end of said body member and a transmitter module to transmit said energy signals.

29. The method of claim 28, wherein said transmitter module includes a laser module to transmit a laser signal, and step (a) further includes:
   (a.1) transmitting said laser signal from said arrow toward said target.

30. The method of claim 29, wherein said laser module is disposed within said point member.

31. The method of claim 29, wherein said point member includes a point insert for insertion within said body member and a tip disposed at a point insert distal end, and wherein said laser module is disposed within said point insert.

32. The method of claim 29, wherein said laser module is disposed within said nock member.
33. The method of claim 32, wherein said nock member includes a plurality of prongs disposed at a nock member proximal end to receive a string of said bow and said laser module includes a power switch disposed between said prongs, and step (a.1) further includes:
   (a.1.1) activating emission of said laser signal in response to reception of said bow string between said prongs.

34. The method of claim 32, wherein step (a) further includes:
   (a.2) disabling emission of said laser signal in response to expiration of a predetermined time interval after propelling said arrow from said bow.

35. The method of claim 28, wherein said arrow further includes an audio indicator, and step (a) further includes:
   (a.1) emitting audio signals to identify a location of said arrow.

36. The method of claim 28, wherein said arrow includes at least one of reflective material and retroreflective material disposed thereon, and step (a) further includes:
   (a.1) reflecting light from said material to identify a location of said arrow.

37. The method of claim 29, wherein step (a.1) further includes:
   (a.1.1) illuminating intended target sites with said transmitted laser signal during said aiming of said arrow.

38. The method of claim 29 further including:
   (b) receiving and reflecting said laser signal at said target to indicate laser signal impact locations on said target; and
   (c) adjusting at least one of configuration and operation of said bow in accordance with said impact locations.

39. The method of claim 38, wherein step (c) further includes:
   (c.1) adjusting at least one of a sight of said bow, balance of said arrow, and aim of said arrow in accordance with said impact locations.
40. The method of claim 29, wherein said archery training system includes said target, a sensing device and a processor, and said method further includes:
(b) detecting impact locations of said laser signal on said target via said sensing device; and
(c) processing and evaluating information associated with said detected impact locations from said sensing device and displaying information relating to said evaluation and an image of said target with indicia indicating said detected impact locations on said target.

41. The method of claim 40, wherein said impact location information includes coordinates of detected impact locations.

42. The method of claim 40, wherein said impact location information includes captured images of said target including said impact locations, and step (c) further includes:
(c.1) determining coordinates of detected impact locations within said captured target images.

43. The method of claim 40, wherein step (c) further includes:
(c.1) determining a score for a user by accumulating score values of target locations impacted by said laser signal.

44. The method of claim 40, wherein said sensing device includes a camera.

45. The method of claim 40, wherein step (c) further includes:
(c.1) determining parameters relating to at least one of a time of flight of said arrow to said target and zeroing a sight of said bow.

46. The method of claim 40, wherein step (c) further includes:
(c.1) tracking movement of said arrow based on said impact location information.

47. The method of claim 46, wherein step (c) further includes:
(c.2) analyzing said tracked movement of said arrow and providing information relating to balancing said arrow.