Source: <https://hackaday.io/project/183279-accelstepper-the-missing-manual/details>

Steppers motors deserve to be used in our projects much more than they are. Their use in 3D printers has brought the prices for the motors and drivers down dramatically. But the libraries to drive them lag behind. The Stepper library, part of Arduino, is very limited since it blocks and only allows one motor at a time to move.  The AccelStepper library, created by Mike McCauley and easily installed using the Arduino Library Manager, overcomes these restrictions, but is considered difficult to use. The purpose of this manual is to explain AccelStepper so its use can become much more widespread.

**Using the AccelStepper Library - Overview**

The AccelStepper library is a library for Arduino written in C++. To use it, you construct (or "instantiate" in C++ speak) named objects of AccelStepper type. These software objects typically have "motor" or "stepper" as part of their names and are related directly to physical stepper motors and their interface electronics ("drivers"). Several different interfaces are supported. The appropriate one for an individual application must be specified when the object is constructed. Once an object is constructed, the various functions (called "member functions") provided in the library may be used to control the objects. I find it helps to break these into groups. The first group is *setup functions* that specify physical capabilities (such as speed and acceleration) of the motor and physical values (such as position to move to). The next group are the *functions that actually move the motor* by sending it signals that will cause steps. These functions use the values from the setup functions to control the motion. Next are the *functions that report information* about the status of the motion. Then come the *pin management functions* that configure and control the pins that interact with the driver. These functions will be discussed below, but first it is good to understand how AccelStepper works.

**Motion Overview**

 A stepper moves when it receives an electrical signal that causes the motor to take a step. The AccelStepper library only has one callable function that causes motion: runSpeed(). Other functions that result in motion call runSpeed() to produce the actual steps. Each such function has the word "run" in its name. The motion functions are of two types: constant speed (limited by the current value of speed), and variable speed (limited by settings of acceleration and maxSpeed, and by position relative to the target). Each of these types contains blocking and non-blocking functions. Blocking functions will run until a stop condition occurs, but no other code will run until they complete. Non-blocking functions cause a single step (if a step is due - see below) and return immediately in any case. Since each call to a non-blocking function only makes at most a single step, they must be called as often as possible; usually in the main loop. Otherwise the motor will not be stepped at the desired speed.

The function runSpeed() determines when a step is to be taken. runSpeed() subtracts the time of the last step from the current time. If the result is greater than or equal to the value of stepInterval ( we say, *"A step is due."*), runSpeed will increment (or decrement, as required) currentPosition, call step(), and update the time the last step was taken. (step() is an internal function - not directly callable. It causes the correct electrical signal to be sent to the interface.) Each call to runSpeed() repeats this process, so runSpeed() must be called at least speed times per second. Usually, this means putting a call to runSpeed() in loop(). Calling runSpeed() when no step is due does nothing

The controlling variable for runSpeed() is stepInterval so we need to understand how AccelStepper calculates it. An internal variable, stepInterval is not directly manipulated by the user. In the simplest case, calling setSpeed() will cause a new value of speed - and stepInterval - to be calculated. The value of speed will be limited to +/- maxSpeed. That value may be changed with setMaxSpeed(). Speed and direction are tracked separately so that stepInterval is always positive; direction is dependent on the sign of speed (in setSpeed()), or the direction of currentPosition relative to targetPosition.

"Ok, fine," you say. "I get constant speed, but how does a motor accelerate or run to a position?" Good question! To do both of those, the run() function is used. The run() function first calls runSpeed() to cause a step (if it is due, as defined above) at the current speed and direction. Then it calls computeNewSpeed(). The function computeNewSpeed() computes a new speed (stepInterval) and sets that as the current speed.

In full detail, computeNewSpeed() forces computation of a new instantaneous speed (stepInterval) and sets that as the current speed. It is called by the library:

* after each step if using run() or runToPosition() or runToNewPosition().
* after a change to maxSpeed through setMaxSpeed().
* after a change to acceleration through setAcceleration().
* after a change to target position (relative or absolute) - through move() or moveTo().
* after a call to stop() - through move().

It will increase (or decrease) the speed based on position (distance to target determines if it's time to slow down or speed up), acceleration (higher or lower), and maxSpeed (has it been reached?). Note that speed values set by setSpeed() are ignored and are indeed overwritten by this function. There is no need to call this function directly and that should not be done.

Other functions that will modify stepInterval include setCurrentPosition() which sets speed and stepInterval to 0. Also, any time setSpeed() is called, it calculates a new stepInterval based on the specified speed. The value will be limited by the value of maxSpeed. As mentioned above, this value will only be used if runSpeed() is used; it will be ignored and overwritten if run() is used. Finally, the constructor also sets stepInterval to 0, so there will be no motion until a function that sets it is called. Typically, setMaxSpeed() is called followed by either setSpeed() or moveTo().

The other functions that will cause motion include runSpeedToPosition(), which checks to see if the target position has been reached and calls runSpeed() if it hasn't. Another is runToPosition(), which simply calls run() until the target position is reached - that is, it blocks until position is reached. Finally, runToNewPosition() allows a new position to be specified, then calls moveTo() to set that as the target, and calls runToPosition() to do the move.

Let's summarize how AccelStepper works. When an AccelStepper object is created, maxSpeed and acceleration are set to 1.0. currentPosition and targetPosition are set to 0, and speed is set to 0.0. In the simplest case to begin motion, setSpeed() must be called to set a speed for subsequent calls to runSpeed(). Using the default values, speed will be limited to 1.0 steps per second. Now call runSpeed() as often as possible - usually in the main loop. The motor will run continually at a constant speed. SetSpeed() may be called with a negative number to cause motion in the opposite direction.(setMaxSpeed() does not have to be called, but speed will be limited to 1 step per second or less.)

Alternatively, moveTo() may be called to specify a new target position. Calling setSpeed() is unnecessary, since speed will be calculated by computeNewSpeed() which is called by moveTo(). Calling run() instead of runSpeed() will cause the motor to accelerate to maxSpeed and run toward the targetPosition. As the targetPosition is approached, the motor will be slowed and will stop when the target position is reached. Further calls to run() will cause no motion until a new moveTo() or move() call is made. If more rapid acceleration and deceleration are desired, then setAcceleration() should be used. Each time run() is called, the value of speed is calculated by computeNewSpeed() (an internal routine that should not be called directly). Any value set by setSpeed will be ignored. These functions will be described in full detail below.

With this understanding in place, let's now look at the details of the functions in AccelStepper.

**Constructing an AccelStepper Object**

You can have multiple simultaneous steppers, all moving at different speeds and accelerations, provided you call their run(), or runSpeed(), functions at frequent enough intervals. These functions and their operation will be discussed further below in the Movement Functions section. To construct an AccelStepper object, you must know the type of driver being used and the pin numbers used to control it. Here is the constructor prototype:

AccelStepper(uint8\_t interface = AccelStepper::FULL4WIRE, uint8\_t pin1 = 2, uint8\_t pin2 = 3, uint8\_t pin3 = 4, uint8\_t pin4 = 5, bool enable = true)

The key item is the *type of interface*(driver) being used. This will depend on the type of stepper motor you are using and possibly the mode it's in. The type should be specified using terms that are defined in an enum in the AccelStepper.h file. The commonest drivers are the step-and-direction driver, such as the a4988 driver; the dual-H-bridge driver, such as the L298 or TB6612 driver; or the driver for unipolar motors, such as the ULN2003. These are specified, using the AccelStepper terminology, like this:  
AccelStepper::DRIVER  (Step-and-direction Driver, 2 driver pins required. Note that any use of microstepping doesn't matter here. The driver only cares about steps.)  
AccelStepper::FULL4WIRE  (4 wire full stepper, 4 motor pins required. For a Dual-H-Bridge controller or unipolar driver. This is the default.)  
The following interfaces are ones I have no experience with, but are supported by the library.  
AccelStepper::FULL2WIRE (2 wire stepper, 2 motor pins required.)  
AccelStepper::FULL3WIRE (3 wire stepper, such as HDD spindle, 3 motor pins required.)  
AccelStepper::HALF3WIRE (3 wire half stepper, such as HDD spindle, 3 motor pins required.)  
AccelStepper::HALF4WIRE (4 wire half stepper, 4 motor pins required.)  
The last interface is used primarily by Adafruit for their motor interface board. It is best documented by Adafruit and I will not discuss it further.  
AccelStepper::FUNCTION (Use the functional interface, implementing your own driver functions, as Adafruit does.)

Many internet examples I have seen use numbers for the interface types instead of the values shown above. There is no reason to do this and is considered poor form. If a later revision of the library changed the values, direct use of numbers might fail. Using the enum names would always work.

After the interface type, the next arguments are the Arduino pins connected to the interface.  
*Pin1*: Arduino digital pin number for motor pin 1. Defaults to digital pin 2. For an AccelStepper::DRIVER (interface==1), this is the Step input to the driver. (Low to high transition means to step)  
*Pin2:* Arduino digital pin number for motor pin 2. Defaults to digital pin 3. For an AccelStepper::DRIVER (interface==1), this is the Direction input to the driver. High means one way; low the other.  
*Pin3:* Arduino digital pin number for motor pin 3. Defaults to digital pin 4.  
*Pin4:* Arduino digital pin number for motor pin 4. Defaults to digital pin 5.

The Arduino pins that the motor interface uses will be initialized to OUTPUT mode during the constructor by a call to enableOutputs(), so there is no need to initialize them in setup(). This behavior may be suppressed if not desired by using enable, the final argument to the constructor. If this is true (the default), enableOutputs() will be called to enable the output pins at construction time. If enable is false, enableOutputs() will not be called at construction. The user must call it before the motor will run. Although it may not be obvious, it is not required to make enable true in order to use the enableOutputs() and disableOutputs() functions, or to define an enable pin. This enable only causes the enableOutputs() function to be called when an AccelStepper object is constructed. EnableOutputs() and disableOutputs() are discussed below. If an enable line is also needed, call setEnablePin() after construction. You may also invert the interface pins using setPinsInverted(), as explained below.

//Example using a driver that accepts step/direction input. An enable pin is not used so enable = true (the default) need not be specified.

// Define pin connections

const int dirPin = 4;

const int stepPin = 5;

// Creates an instance

AccelStepper myStepper(AccelStepper::DRIVER, stepPin, dirPin);

//Example using a driver that needs four wire control. This could be for a dual H-bridge or a FET array like a ULN-2003 for a unipolar stepper. No enable pin is used.

// Motor Connections

const int In1 = 8;

const int In2 = 9;

const int In3 = 10;

const int In4 = 11;

// Creates an instance - Pins entered in sequence IN1-IN3-IN2-IN4 for proper step sequence

AccelStepper myStepper(AccelStepper::FULL4WIRE, In1, In3, In2, In4);

**Setup Functions**

These functions set values for later use by the motion functions. They should be called initially to set up desired conditions, then may be called again to change them. Positive and negative values for direction are arbitrary depending on how the driver is wired. The key point is that they move the motor in two opposite directions. Positive and negative values for speed don't matter, speed is stored as an absolute value.  
**moveTo((long) absolute\_position)**  
  *Argument:*absolute\_position in steps. The desired absolute position of type long. May be positive or negative.  
Set the target position. The run() function will try to move the motor (at most one step per call) from the current position to the target position set by the most recent call to this function. Caution: moveTo() also recalculates the speed for the next step.  If you are trying to use constant speed movements, you should call setSpeed() after calling moveTo(). If moveTo() is called while the motor is moving,the target position is changed immediately and the acceleration algorithm is used to calculate the new speed. If the motor is running at a high speed in a particular direction and the new target position is in the opposite direction, the motor will continue to run in the same direction, decelerate to stop, then accelerate in the new direction until it approaches the new target and slows to a stop.  
*Example* to move to the absolute position 2038. The new value of targetPosition is 2038 after calling this function.  
  myStepper.moveTo(2038);  
**move((long) relative\_movement)**  
 *Argument:*relative\_movement in steps. Desired movement relative to the current position. Argument type is long and it may be positive or negative.  
Set the target position relative to the current position. Caution: move() also recalculates the speed for the next step.  If you are trying to use constant speed movements, you should call setSpeed() after calling move(). If move() is called while the motor is moving, the result is just like moveTo(). The only difference is the way the new target position is calculated.  
*Example* to move one step in the positive direction relative to the current position.  
  myStepper.move(1);  
**setMaxSpeed((float) speed)**  
  *Argument:* speed in steps per second. Desired maximum speed as a floating point value. A negative value may be passed, but will be stored as an absolute value.  
Set the maximum allowable speed. Usually, this function will be the first one called when using an AccelStepper object (that is, a stepper motor.) If the run() function is used, then the motor will accelerate to this speed. Any speed value set by setSpeed() will be ignored. If runSpeed() is being used, then setSpeed() must be called after setMaxSpeed(). **Caution:** the maximum speed achievable depends on your processor and clock speed. Values as high as 4000.0 might work - but 1000.0 is a safe bet. Speeds that exceed the maximum speed supported by the processor may result in non-linear accelerations and decelerations. The default maxSpeed is 1.0 steps per second.  
*Example*setting the maximum speed to 1000.0 steps per second.  
  myStepper.setMaxSpeed(1000.0);  
**setAcceleration((float) acceleration)**    
  *Argument:* acceleration in steps per second per second as a floating point value. May be specified as negative, but only the absolute value is stored.  
Sets the acceleration/deceleration rate. Acceleration is used by run() to increase (or decrease) the speed the motor is being stepped at. This is an expensive call since it requires a square  root to be calculated. Don't call more often than needed. Default value is 1.0.  
*Example* setting the acceleration to 50.0 steps per second per second.  
  myStepper.setAcceleration(50.0);  
You might well ask, "I don't get acceleration! Exactly what does steps per second per second mean?" Let me explain.  
Start with the maxSpeed set to 200.0 steps per second and acceleration set to 50.0 steps per second per second. Let our program call run() repeatedly. The run() function will start moving the motor at 0.0 step per second and increase that speed by 50 steps per second every second the motor runs. Consider the speed and position at the end of one second. The motor will start at 0.0 steps per second and will have accelerated by 50 per second in one second. It will have moved about 25 steps (about the average speed for the first second; ~1/2 \* 50). Acceleration is constant, so here are the values of speed and position (distance moved) as time passes. These are the actual results from UnoAccelStepperRunDemo.ino. Since each call to run() causes an update, the values reported each second are somewhat different than you might expect. You can experiment with that sketch to learn more about acceleration. You don't even need to connect a motor or driver to see the results, but it's more fun if you do!

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Second: | 1 | 2 | 3 | 4 | 5 | 6 |
| Speed: | 53 | 103 | 153 | 200 | 200 | 200 |
| Distance: | 28 | 106 | 235 | 413 | 613 | 813 |

What if acceleration is fractional? Works fine, just slow acceleration. An acceleration value of 1e-14 has been tested. The algorithm still works, but there will be no motion for a very long time. (I got tired of waiting!)  
**setSpeed((float) speed)**   
  *Argument:* speed in steps per second as a floating point value. May be positive or negative.  
Sets the desired constant speed for use with runSpeed(). The speed will be limited by the current value of setMaxSpeed() to +/- maxSpeed. This speed will be used as long as runSpeed() is called and results in constant speed operation. If run() is called, this value will be ignored (and overwritten). Speeds of more than 1000 steps per second may be unreliable. Very slow speeds may be set (eg 0.00027777 for once per hour, approximately. Speed accuracy depends on the Arduino crystal. Jitter depends on how frequently you call the runSpeed() function.    
*Example* setting the speed (for constant speed operation) to 200.0 steps per second.  
  myStepper.setSpeed(200.0);  
**setCurrentPosition((long) position)**  
  *Argument*: The desired value of the position in steps of wherever the motor happens to be right now. It can be positive or negative and is of type long.  
This function will make the current motor position and the target position equal to the value specified. For example, if you have moved the motor to an initial position (say 213) and call setCurrentPosition(100), the current position and the target position will both be set to 100. it will take 100 positive steps to reach position 200 (if you call moveTo(200)) rather than 13 steps in the negative direction. This function will also reset the value of speed to 0.0. This function is most useful for setting a zero position on a stepper after an initial hardware positioning move.  
*Example* setting the current position to 0 steps.  
setCurrentPosition(0);  
**Warning: Do not call this function while a move is in process!**The values of current position and target position will be changed immediately and speed will be immediately set to 0. This will force the motor to try to stop instantly and will most likely result in missed steps and possible damage to your system. Be sure the stepper has come to a stop before calling setCurrentPostion().  
**stop()**  
This function will set a new target position that causes the stepper to stop as quickly as possible, using the current speed and acceleration parameters. A call to runToPosition() will bring the motor to a stop. Repeated calls to run() will do the same thing. The motor will take more steps in the direction it is going before stopping. This could be several steps if the motor is running fast and the acceleration is low.

**Motion Functions**  
Full explanation of how AccelStepper uses these functions to control motion is given above in the Motion Overview section. By all means, take time to review that section when you need insight into how these motion functions work. These functions cause the motors to actually run - configuration and setup functions should be called before calling the motion fuctions.  
Consider the *non-blocking motion functions* first.  
**runSpeed()**  
Move one step it if a step is due (as described above), implementing a constant speed as set by the most recent call to setSpeed(). You must call this frequently, but at least once per step interval.  It produces constant speed operation. Since it does not seek a position, it can be used to run a motor continuously. Note that the currentPosition will be incremented or decremented by runSpeed(), but the targetPosition will be ignored.  
The function will return true if the motor was stepped, and false if not. Note this is not the same as the behavior of run()! The runSpeed() function may be called several times before it actually causes a step to be taken. It will return false every time it does not step; true is returned only if it steps. On the other hand, run() may also be called many times before causing a step, but it will return true every time until the motor stops.  
**Caution:**Since acceleration is not used by runSpeed(), setting a high value for speed, then calling runSpeed() may cause the motor to stall. To achieve maximum motor speed, use run() and allow the motor to accelerate.  
*Examples* of use of runSpeed(): UnoAccelStepper\_ConstantSpeed.ino (simplest version), UnoAccelStepperExper\_1 (simple, but reports results every second), and also UnoAccelStepper\_speedControl.ino which uses a pot to vary speed and reports results every second. Experiments to try include setting max speed and speed to very high values and see if your motor will run or stall. Then try same with speedControl to ramp up slowly and see if the high speed is possible.  
**run()**  
The run() function calls runSpeed(), then calls computeNewSpeed() (see description in Motion Overview, above). A step will be taken if it is due and currentPosition does not equal targetPosition. This function implements acceleration and de-acceleration to move the motor. You must call this as frequently as possible, but at least once per minimum step time interval,preferably in your main loop. The function will return true if the speed is not zero or the final position has not been reached. (That means the motor is being stepped.) If these conditions are met, true will be returned regardless of whether or not the motor stepped. Note that each call to run() will make at most one step, and then only when a step is due. *Example* of use of run(): UnoAccelStepperRunSimple.ino- A simple demo of run(). Another sketch, UnoAccelStepperRunDemo.ino is a nice, clean run() demo also that reports every second to the serial monitor - helps to build insight into how AccelStepper works. Try various maximum speeds and accelerations and see what's reported.  
**runSpeedToPosition()**  
Executes runSpeed() unless the targetPosition is reached. This function needs to be called often just like runSpeed() or run(). Runs the motor at the currently selected speed unless the target position is reached. Does not implement accelerations.  
The function will return true if it stepped and false otherwise. If you want to know if the target position has been reached, call distanceToGo() described below.  
*Example*of use of runToPosition(): UnoAccelStepper\_ProportionalControl.ino Note use of setSpeed() after call to moveTo().

Now let's look at the *blocking motion functions*. "Blocking" means no other program code runs until these functions complete.  
**runToPosition()**  
This function will continually call run() - blocking other statements - until it returns false - meaning the desired position has been reached. It moves the motor (with acceleration/deceleration) to the target position and blocks until it is at position.    
**runToNewPosition((long) absolute position)**  
Executes moveTo(position), then runToPosition().  
Moves the motor (with acceleration/deceleration) to the new target position and blocks until it is at position.  
  *Argument:*absolute\_position in steps. The desired absolute position of type long. May be positive or negative.  
*Example* of blocking move to 200.  
  runToNewPosition(200);

To summarize:  
- Use setMaxSpeed(), then setSpeed() to initialize, then call runSpeed() repeatedly to step the motor at constant speed. Stop calling runSpeed() to stop the motor.  
- Use setMaxSpeed(), then moveTo() or move() to set a target, then call runSpeedToPosition() repeatedly to step the motor at constant speed until the target position is reached.  
- Use setMaxSpeed(), then setAcceleration(), then moveTo() or move() to set a target, then call run() repeatedly to accelerate the motor, move to the target, and decelerate to a stop.  
Only one of the run functions needs to be called in the loop.  
- If blocking behavior is desired, use setMaxSpeed(), then setAcceleration(), then moveTo() or move() to set a target, then call runToPosition(). The motor will behave as though run() were repeatedly being called, but no other code can be executed until the target position is reached. Alternatively, using runToNewPosition() allows the move() or moveTo() calls to be skipped.

It is a bad idea to put delay() calls in the loop with run()! This causes the loop to run slowly and will limit the speed of the motors.

Just to be very clear: if run() is being used, setSpeed() does not set the speed! Only computeNewSpeed() will set the speed as described in Motion Overview, above.  
The function stop() does not stop the motor! It will set a new speed and target. Call run() or runToPosition() to cause a stop.  
The functions move() and moveTo() do not cause motion. The function run() must be called to cause motion. (runToPosition() will also do it.)  
If runSpeed() is being used, the value of speed is all that matters. The value of speed is the last value set by setSpeed(), or calculated by computeNewSpeed() if run() was used.

**Information functions**  
These may be called to read back the values of certain variables, or check status of motion. Note that speed is always in steps per second and position is in steps from the 0 position. Direction is considered clockwise or counterclockwise, but these are arbitrary depending on how the motor is wired to the interface electronics. Positive values of position are opposite negative values.  
**maxSpeed()**  
Maximum speed as set by setMaxSpeed - in case you forgot. Returns a floating point value.  
**speed()**  
Return the most recent speed as a floating point value in steps per second. This could be speed set by setSpeed() if only runSpeed() has been called, or speed calculated if run() is called or if a positioning routine has been called.  
**targetPosition()**  
Target position as set by move() or moveTo(). Returns a long.  
**currentPosition()**  
Where the motor is currently. Returns a long.  
**distanceToGo()**  
Equal to targetPosition - currentPosition as a positive integer. Returns a long. The distance from the current position to the target position in steps.  
**isRunning()**  
Return true if the speed is not zero or distanceToGo is not 0.

**Pin Management functions**

The interface pins send the signals to cause stepping. These functions may be used to further configure and control them. **enableOutputs()**  
Enable interface pins as outputs by setting them to OUTPUT mode. Called automatically by the constructor. It only needs to be called directly if disableOutputs() has been called. If the enable pin has been defined, this function will also manage it.  
**disableOutputs()**  
Set the interface pin outputs to all LOW and invert (disable) the enable pin if it has been set. Depending on the design of your electronics this may turn off the power to the motor coils, saving power. This is useful to support Arduino low power modes: disable the outputs during sleep and then reenable with enableOutputs() before stepping again.  
**setPinsInverted()**This function can invert the sense of any interface pin. The pins are positional; setting the value for a pin true inverts it while setting it false leaves it un-inverted. This function is used most often to invert the enable signal. There are two forms of this function:  
  *setPinsInverted (directionPin, stepPin, enablePin)*This form is for step/direction drivers. To set just the enable signal inverted, use setPinInverted(false, false, true). If an enable pin is not used, no value needs to be specified.  
 *setPinsInverted(pin1, pin2, pin3, pin4, enablePin)* This form is for the 2, 3, and 4 pin driver types. Place a value of true in the position of any pin that is to be inverted. If an enable pin is not used, *a value must still be specified!* (This is a bug - but it's easy to work around.)  
If the enable pin is to be inverted, call setPinsInverted() before calling setEnablePin(). If pins other than the enable pin are to be inverted, you may want to create the AccelStepper objects with a concluding argument of false. That will keep the enableOutputs() function from being called until the pins are inverted. Then call enableOutputs().  
*Example*inverting only the enable pin of a step/direction driver.  
setPinsInverted (false, false, true);  
*Example* inverting only the step/direction pins of a step/direction driver. The enable pin is not used and may be omitted.  
setPinsInverted (true, true);  
*Example* inverting the interface pins of a 4 pin driver. The enable pin is not used but must be specified anyway.  
setPinsInverted (true, true, true, true, false);  
**setEnablePin(enablePin)**  
Specify the desired pin number to use to control the enable signal. If no enable pin signal is needed, there is no need to call this function. The pin will be configured as an OUTPUT, and the correct value will be set, when this function is called. For this reason, if the enable signal is to be inverted, setPinsInverted() should be called before setEnablePin(). As mentioned above, enableOutputs() and disableOutputs() will correctly manage the enable pin, along with any inversions.  
*Example* setting the enable pin to pin 7.  
setEnablePin(7);  
**setMinPulseWidith(unsigned int minWidth)**  
This function only affects the step pulse width for step/direction drivers. Measuring with my oscilloscope, the minimum pulse width is 16uSec. Using this function, it is possible to increase the pulse witdth in increments of 1uSec. Most drivers seem to do fine without any adjustment to this value and I'd advise not to mess with it unless you know what you're doing. That said, a recent thread in the forum revealed that the TB6600 driver did not work reliably until setMinPulseWitdth(20) was used, making the pulse 35uSec wide. YMMV.  
*Example* setting the minimum pulse width to 30 microseconds (15+15).  
setMinPulseWidith(15);

Let's consider how to use the pin management functions. Suppose we want to invert the Direction pin and use an Enable pin, also inverted. Here's what we need to do. We must start with the construction of the stepper object and keep the interface pins from being initialized.  
  AccelStepper myStepper(AccelStepper::DRIVER, stepPin, dirPin, 0xff, 0xff, false);  
Using "false" in this manner stops initialization of the interface pins so that the Direction pin can be inverted before it is used. Note that we must specify "0xff" (or whatever - it doesn't matter, but 0xff is safe) for the two unused pins so that "false" is in the correct position. To initialize the pins, enableOutputs() must be called, but first any desired pins should be inverted and the enable pin defined.  
Now we can invert the Direction pin and the enable pin. The Step pin is left alone. Invert the enable pin even though it hasn't been defined yet.  
  myStepper.setPinsInverted (true, false, true);  
Now define the enable pin on pin 7 (for example).  
  myStepper.setEnablePin(7);  
The enable pin is now initialized, next we need to make sure it is in the disabled state.  
  myStepper.disableOutputs();  
Everything is ready, so enable the outputs.  
  myStepper.enableOutputs();  
The disableOutputs() function may be used now to power down the interface as desired. Use enableOutputs() to power it up again. NOTE: disableOutputs() will only change the state of the enable pin to the disabled state. That signal must be connected to your driver's enable pin in order to power it down. If you continue to call run() or runSpeed(), steps will continue to be sent to the driver and if it does not have an enable pin, it will continue to step. To make use of disableOutputs() if your driver doesn't have an enable pin, you should stop calling run() or runSpeed() before calling disableOutputs().

**Example Programs**

If you haven't already done so, now would be a good time to have a look at the demo programs I've included. These were introduced above when runSpeed() and run() were discussed, but I want to be sure they are noticed. You can download them individually and pick only the ones you care about, or download the AccelStepperDemos.zip archive. Three driver types are supported. Just uncomment the one you want to use and comment out the others. These have all been tested on the Uno and the Duemilanova, but should run on any Arduino version supporting AccelStepper. The ElapsedMillis library is used to make printing at one second intervals easy. It can be downloaded using the library manager, or millis() could be used also with a tiny bit of effort.  
UnoAccelStepper\_ConstantSpeed - Uses runSpeed() to drive a single stepper.  
UnoAccelStepperExper\_1  - Easy runSpeed() example with one second report.  
UnoAccelStepper\_speedControl  - Uses pot to control speed. Has reporting. Uses runSpeed() - can do lots of experiments.  
UnoAccelStepperRunSimple  - Stepper bounces between limits. Best simple run() demo.  
UnoAccelStepperRunDemo - shows how run() works. Also demos effects of move and stop functions. Includes reporting every second. Works great for doing many experiments - reporting is very helpful to gain insight.  
UnoAccelStepper\_ProportionalControl  - Uses pot input. Has optional port viewing routine. Prints position info. Shows use of runSpeedToPosition() and setSpeed() after moveTo().