Leading Flying Objects

Stephen M. Watt Western University

J. W. Graham Medal Seminar 13 June 2012, University of Waterloo



Leading

adj.

- 1. guiding, directing or influencing
- 2. of greatest importance or degree

Flying



Objects



Leading Flying Objects



Henry P. Davis

each individual shot.

The average novice gunner The average novice guiner much? No one can ten you they when first confronted with this you find it out for yourself. You problem, usually weighs his own find the distance which you should be average of a state of the other that we over the state of the other the other the other the other the other the other ot problem, ustance which we have a lack of knowledge and experience and considers the task almost im-possible of accomplishment. How-for year you alone can solve the ever, after he makes a few hits, problem. this feeling of incompetence passes to some degree and the first

line of sight is moving ahead of the object all during the time it In any form of wing shooting. The object an during the constraint of the second state game birds, waterfowl or trap space of time, you are building or skeet shooting "clay saucers," in a load which you are building or skeet shooling "clay saucers," space of the you don't even up a lend which you don't even manship is the ability to deter-mine instantly the proper lead for each individual elect than you think you are How much? No one can tell you that;

> How do you allow for different speeds and different angles" The

es to some degree and the first species and different angles." The cardinal rule in shooting efficient interval the first species and different angles. The ple self-evidence speaks for it-self Yon can't hit em if varies the angle, the faster the species the species of the faster the species of the object goes, the the angle of hight and the ve-faster your gut, will be going locity of the shot charge, one well were it passer to the target. So -in versed in mathemata's can first the Reaction Interval the time out the event lead necessary. out the exact lead necessary to it takes you to get the trigger center the target. But by the pulled, your lead is increasing time his mental slide-rule has more on a fast, acute angle shot dished up the answer, the target than on a slower one at a lesser has usually flown on to safer angle Your swing is turnishing bounds. So the good shot learns, comp nation for the speed and

bounds. So the good shot learns, componential for the speed and by experiment to instanctively ap-anyle of the shot without your ply the proper lead. This necessarily, of load of shot is about 15 feet and very otten unconsciously, in long as it flees through the an-the swing-through that is so im-il you are a little too far ahead portant in good shoigun marks-of the object, some of the tabend shot may bite it down, but if you are behind the object, there This is all I can tell you about isn't any doubt about your missing it. If you have hunted many 1. Start your swing behind it. ducks, you have no doubt had the Don't hold your gun still and wait experience of, aiming at the lead for it to come to you. 2. Swing with it, following its front of you and kulling one of flight.

The Trigger Pull

It takes you longer to get the

No one can tell you how far trigger pulled than it does for the to pass it That you must figure load of shot to travel 40 yards. An

out by trial and error. When you average reaction interval takes .20

3. Pass it and pull the trig-

Here's How

leading a flying object.

manship.

ger

ht, you are right. When you niss, of a second to get the load out of the odds are that you didn't pass the gun after your eye says it far enough Remember how the "shoot" as against roughly .15 of start behind the object and swing through the load over a second for the shot to travel through it has the declay targets have been run with-

through it that we are able to dethe sights Do it again the same 40 yards. Some people are slow-way!

Wayi Why can't anyone tell you how are slower, big shot are faster; small shot yeap any accuracy in tossing the shot where the object is going. The mile a minute bird will but the two figures add up to only travel about 13 feet while pull a trigger. When your eye says "shot" you swing fast and pull a slow When your eye says "shot" about and will not consciously with a trigger. You will not consciously you swing fast and pull a slow trigger, you will not consciously have to lead as much as the per-son who doesn't swing so fast pull a trigger. Short "A burd winging 60 mules an trigger. you will not consciously "When your eye says "Short" A burd winging 60 mules an have to lead as much as the per-the message has to travel through hour at right angles to your gun have to lead as much as the per-a set of nerves to tell a set of is doing 88 feet per second. So, son who doesn't swing so fast muscles to pull the trigger and if you held your gun sull, point-the muscles have to pull it. Some ing at a spot the bird is going they never led game at all. At the muscles have to pull it. Some folks have twice as long as others to cross, your eve would have to to get the job done. Don't ask me say "Shot" while the bird was but some of them with a slow re-why. It has been proved. Follow and Pass Target When you start your swing be-hind an object, then follow in the same time. Now no one could object's path until you pass it, even accurately judge a distance the speed of your guin movement of 30 feet at 40 yards on an ob-object--you are overtaking it. As sometimes wonder how we ever your line of sight goes by it, the hit anything' Yet, thousands of

Lewiston Evening Journal October 12, 1955

Henry P. Davis

ever, after he makes a few hits, problem. this feeling of incompetence pass- How do you allow for different es to some degree and the first

leading a flying object.

for it to come to you. 2. Swing with it, following its front of you and kulling one of flight. 3. Pass it and pull the trig-

No one can tell you how far trigger pulled than it does for the to pars it That you must figure load of shot to travel 40 yards. An out by trial and error. When you average reaction interval takes .20

line of sight is moving ahead of the object all during the time it Henry P. Davis In any form of wing shooting, whether the targets be upland game birds, waterfowl or trap or skeet shooting "clay saucers," up a lead which you are building a prime requisite for good marks-manship is the ability to deter-mue instantly the proper lead for out are leading the object more than you think you are How The average novice gunner much? No one can tell you that, you are heading the object more than you think you are heading the object more than you that, you are heading the object more than you that, you have head that when first confronted with this you find it out for yourself. You problem, usually weighs his own find the distance which you should lack of knowledge and experience and considers the task almost time and considers the task almost time of accomplishment. How-for yout, you alone can solve, the ver, after he makes a tew bills, newhere

speeds and different angles" The

this feeling of incompetence pass-es to some degree and the first cardinal rule in shooting effect incy begins to soak in This sin-ple self-evidence speaks for it-self. Yon can't hit 'em if you shoot behind em.' Given the speed of the target. It use, helps you do it. The more speed; the more your gun swings added of the object when you pass Given the speed of the target. It the faster the object goes, the the angle of light and the ve-faster your gun will be going locity of the shot charge, one well wrent it passes the target. So -in versed in mathemat.sc can firmer the target But by the public, your lead is increasing time his mental shde-rule has a taught flown on to safer has tsually flown on to safer has tsually flown on to safer cessarily, is done very quickly and very often unconsciously, in the swing-through that is so in-the swing-through that is so in-they and the object, some of the tai-er so disk application the speed and of the object, application the speed is and the object, there is an lear to full you append the abuit your miss-

Interest How end shot may bite it duwn, out if you are behind the object, there adang a flying object. 1. Start your swing behind it, ducks, you have no doubt had the Don't hold your gun still and wait experience of, aiming at the lead

The Trigger Pull

ht, you are right. When you average reaction anterval takes to clay targets have been run with-the odds are right. When you miss, of a second to get the load out of odds are that you didn't pass the gun after your eye says it far enough Remember how the "shoot" as against roughly 15 of and skeet. It is only because we ones you hit looked to you over a second for the shot to travel through it that we are able to declay targets have been run withstart behind the object and swing through it that we are able to dethe sights Do it again the same 40 yards. Some people are slow-way!

Wayi Why can't anyone tell you how are slower, big shot are faster; small shot yeap any accuracy in tossing the shot where the object is going. The mile a minute bird will but the two figures add up to only travel about 13 feet while pull a trigger. When your eye says "shot" you swing fast and pull a slow When your eye says "shot" about and will not consciously with a trigger. You will not consciously the shot travels its 40 yards. If you swing fast and pull a slow trigger, you will not consciously have to lead as much as the per-son who desn't swing so fast ord will a curve traver. number of the provided and the short have by and you swing fast and pull a slow trye have by and you swing fast and pull a slow trye have by and you swing fast and pull a slow trye have by and you swing fast and pull a slow trye have by and you swing fast and pull a slow trye have by and the short have by and you swing fast and pull a slow trye as a set of nerves to tell a set of is doing 88 feet per second. So, and pulls a quick tryger. I have the muscles have to pull it. Sum the dy our gun still, point the bird is going the bird at the bird was about 30 feet from the crossing action interval probably didn't when you start your swing be-order for both to arrive at the same time. Now no one could on bipect, then follow in the same time. Now no one could if and the lead took care of itself. I repeat that no charts, diagrams the speed of your gun movement of 30 feet at 40 yards on an oh-or tables of figures will give you you are overtaking it. As sometimes wonder how we ever your line of sight goes by it, the hit anything' Yet, thousands of the remotest idea of how to hit a figure on every shot.

"You can't hit 'em if you shoot behind 'em."

Henry P. Davis

line of sight is moving ahead of the object all during the time it Henry P. Davis In any form of wing shooting, whether the targets be upland game birds, waterfowl or trap or skeet shooting "clay saucers," up a lead which you don't even henry transfer to the shooting the shoot of each individual shot.

and the distance winds and experience and considers the task almost in-a bit, that's the right amount possible of accomplishment. How- for you, You alone can solve, the ever, after he makes a few hits, problem. this feeling of incompetence passes to some degree and the first

or skeet shooling clay satisfies up a lead which you take to be a prime requisite for good marks-know about. It isn't being record-ed on your conscious mind. But -mine instantly the proper lead for ou are leading the object more than you think you are How much? No one can tell you that; than you trink you not that; The average novice gunner much? No one can tell you that; when first confronted with this problem, usually weighs his own find the distance which you should find the distance which you should

How do you allow for different speeds and different angles" The

es to some degree and the first cardinal rule in shootiny effic. In the speeds and different angles." The cardinal rule in shootiny effic, helps, ou do it. The more ple self-evidence speaks for it-self. 'Yon can't hit 'em if 'ou speed, the more your gun swings shout behind em.' Given the speed of the targe, the dister the speed; the more your gun swings ahead of the object when you pass. Given the speed of the targe, the faster to object goes, the the angle of light and the ve-faster your gun, will be going locity of the shot charge, one well, when it passes the target, So -in versed in mathemata's can figure the reaction Interval the time out the exact lead necessar: to it takes you to get the trigger tenter the target. But by the pulled, your lead is increasing time his mental shde-rule has more on a fast, acute angle shot dished up the answer, the target than on a slower one at a lesser has usually flown on to safer angle Your swing is turnishing bounds. So the good shot learns, comp nation for the speed and

bounds. So the good shot learns, composition for the spectral and by experience to instanctively apply the proper lead. This necessarily, is done very quickly, Λ load of shot is about 15 feet and very often unconsciously, in long as it flies through the arr. It is you are a little too far ahead portant in good shotgun marks- of the object, some of the tail, but it for the it down, but end shot may bite it down, but if you are behind the object, there This is all I can tell you about isn't any doubt about your missing it. If you have hunted many 1. Start your swing behind it. ducks, you have no doubt had the Don't hold your gun still and wait experience of, aiming at the lead 2. Swing with it, following its front of you and killing one of the for the former to you. flight. 3. Pass it and pull the trig-

The Trigger Pull

reference of the second second

out by trial and error. When you average reaction interval takes .20 the sights Do it again the same 40 yards. Some people are slow-way!

Here's How

leading a flying object.

manship.

far to pass it?

mans different lengths of time to the time your eye says "shoot" pull a trigger.

ht, you are right. When you niss, of a second to get the load out of the odds are that you didn't pass the gun after your eye says it far enough Remember how the "shoot" as against roughly .15 of start behind the object and swing through the load over a second for the shot to travel through it has the declay targets have been run withthrough it that we are able to de-

Why can't anyone tell you how ar to pass it? Because it takes different hu-about one-third of a second from the shot where the object is going. The mile a minute bird will only travel about 13 feet while the shot travel is to the formation of the shot travel is to the shot travel is to the shot where the object is going. the shot travels its 40 yards. If you swing fast and pull a slow trigger, you will not consciously have to lead as much as the perunii the shot travels 40 yards. When your eye says "Shot." The message has to travel travels 40 yards. A burd winging 60 mules an have to lead as much as the per-bio travel travel travel travels 40 yards. A burd winging 60 mules an have to lead as much as the per-bio travel travel travel travel travel travels 40 yards. A burd winging 60 mules an have to lead as much as the per-son who doesn't swing so fast and pulls a quick trigger. I have the observe to pull it. Some ing at a spot the bird is going to get the job done. Don't ask me say "Shot" while the bird was about 30 feet from the crossing pont of the bird and the shot in the same time. Now no one could if any. They just swung through object's path until you pass it, the speed of your gun movement object—you are overtaking it. As sometimes wonder how we ever your line of sight goes by it, the hit anything' Yet, thousands of

Here's How

- Start your swing behind 1. it. Don't hold your gun still waiting for it to come to you.
- 2. Swing with it, following its flight.
- Pass it and pull the 3. trigger.

A Few Stories

- Maple
- Axiom & Aldor
- Symbolic-Numeric Algorithms for Polynomials
- MathML
- Descartes
- Symbolic Exponents
- Mathematical Handwriting Recognition
- Directions in Teaching

Maple

• Software for symbolic mathematical computing.

$$diff(\sin(\exp(a \cdot x) + x), x) \\ \cos(e^{ax} + x) (a e^{ax} + 1)$$

- Geddes and Gonnet, U Waterloo Dec 1980.
- Joined as NSERC student Jan 1981.
- Maplesoft founded 1988.

Maple

- Lightweight design, based on compiled kernel and interpreted library.
- Run a dozen students on a TSS.
- Run a single user on a personal computer.
- Do more in smaller places.









MapleSim for CAE



Axiom & Aldor

- "A Language for Computational Algebra" Jenks and Trager, 1981.
- Proposed a strongly typed language for generic algorithms. Type system based on modern algebra.
- Similar direction to own developing thoughts.
- Met group at "Computers in Math" at Courant Institute.
- Joined team in 1984.

Axiom & Aldor

- Ambitious system, "Scratchpad II"
- Type categories, run-time generics.
- Shoehorned into 24 bit shared address space.
- Dial in dedicated research TSS brought to knees.



Axiom & Aldor

- Move to Unix ca 1987.
- Re-invented language based on dependent types.
- C-implementation of stand-alone compiler.
- Release via NAG Ltd (UK) as Axiom and Aldor (early 90s)
- Failed commercially. Limited open source use.
- Too early.
- Influential. Views, C++, Magma, Sage, MatheMagix,...

• What is a polynomial GCD?

$$p = x^2 + 2x + 1$$
$$q = x^2 - 1$$

• What is a polynomial GCD?

$$p = (x+1)(x+1)$$
$$q = (x+1)(x-1)$$
$$g = \gcd(p,q) = x+1$$

• Compute using Euclidean algorithm.

• Slightly different coefficients....

$$p = x^2 + 2x + 1.0000001$$
$$q = x^2 - 1$$

$$g = \gcd(p, q) = 1$$

- How to find that the second problem is "close to" the first problem and there is a non-trivial answer?
- ≤1995, state of the art was

"Run the Euclidean algorithm with a fuzzy zero test."

• What does this mean???

• With Corless, Gianni, Trager (1995) proposed to use ideas from backward error analysis.

Given $p, q \in \mathbf{R}[x]$ of degrees d_p, d_q

and $\epsilon > 0$,

do there exist $\Delta p, \Delta q \in \mathbf{R}[x]$ of degrees $\leq d_p, d_q$

with $||\Delta p||, ||\Delta q|| \le \epsilon$

such that $gcd(p + \Delta p, q + \Delta q)$ is nontrivial?

If so, find them.

- Well defined question.
- Can answer using any approach.

• Then polynomial decomposition, factorization, etc.



mplementation of symbolic-numeric algorithms Model construction with approximate algebraic algorith molementations of solvers on multi-c

MathML

<math>

$$\int_{\mathcal{C}} \mathrm{d}\,\omega \; = \; \int_{\partial \mathcal{C}} \,\omega$$

$$\left(\frac{p}{q}\right)\left(\frac{q}{p}\right) = (-1)^{\frac{p-1}{2}\cdot\frac{q-1}{2}}$$

 $G(E/F) \;=\; G(K/F) \;/\; G(K/E)$

$$abla^\mu
abla_\mu A^
u -
abla^
u
abla_\mu A^\mu = j^
u$$

$$\partial_{n-1}\partial_n c = 0$$

MathML

- OpenMath effort initiated 1993 for data exchange.
- Unfulfilled <math> element in HTML 3.2 Jan 1997.
- Initial, unchartered Math WG defining microsyntax for <math>.
- Internecine rivalry between syntax and semantics camps coming from TeX, Mathematica and SGML.

MathML

- Convened "HTML-native" math group to form unified proposal.
- XML proposed recommendation December 1997.
- MathML proposed recommendation February 1998.
- Supported in major browsers, computer algebra systems, incorporated in HTML 5.

Login/Register 🌲



Q.

info@descartes.com +1 (519) 746-8110





NASDAQ:DSGX TSE:DSG

- Global leader in on-demand software-as-a-service solutions for logistics-intensive businesses.
- More than 35,000 trading partners networked.
- Solutions to route, schedule, track and measure delivery resources; plan, allocate and execute shipments; rate, audit and pay transportation invoices; file customs and security documents for imports and exports.

- Re-use data for multiple purposes, e.g. warehousing, routing, customs
- Multiple transportation partners on network enable end-to-end treatment of goods.
- Internet of things on the move.

- Board member since 2001. Chairman 2003-2007.
- Turn-around needed.
- Appointed Art Mesher President/CEO in Nov 2004.
- Fired customers, reduced staff, focused.
- Strategic acquisitions. One example....







C-TPAT Eligibility

In April of 2002, Customs and Border Protection initiated the Customs Trade Partnership Against Terrorism (C-TPAT) voluntary program to combat potential terrorists threats that was open to enrollment by Importers only. In the years that have followed, CBP has expanded the scope of the program to include additional business entities within the international supply chain. At the present time, there are over 14,000 companies actively involved with the C-TPAT process. CPB Agents have participated in over 4000 Validation reviews and have met with C-TPAT Partners in over 50 countries.

To be eligible to participate in this vital security program you must be one of the following business entities:

Are YOU Eligible for C-TPAT Certification? Click the Link for C-TPAT Eligibility!

- 3PL Third Party Logistics Provider
- Air Carriers
- Air Freight Consolidators, Ocean Transportation Intermediaries (OTI) and Non-Vessel

• Acquired

Flagship Customs Services (US) USD 29mm June 2006

ViaSafe (Canada) USD 9mm Apr 2006

- Mandatory criteria
 - \Rightarrow Sold out



Symbolic Exponents

• "Computer Algebra's Dirty Little Secret"

$$\frac{(k-k^n)}{k}$$

$$\frac{k-k^n}{k}$$

simplify(%)

$$-\frac{-k+k^n}{k}$$

Symbolic Exponents

• CAS do not handle symbolic degrees, dimensions, characteristics, etc.

$$x^{2n} - y^{2m} = (x^n + y^m)(x^n - y^m)$$

$$x^{n^2+3n} - y^{2m} = \left(x^{n(n+3)/2} + y^m\right) \left(x^{n(n+3)/2} - y^m\right)$$

$$16^{n} - 81^{m} = (2^{n} - 3^{m})(2^{n} + 3^{m})(2^{2n} + 3^{2m})$$

• Algorithms for gcd, factorization, fn decomposition, etc.

Mathematical Handwriting Recognition

Augdruck unter der Alammer rechts Gresbewegtenthammunktes in der Gette aus me? Aufur 22 = me? 71-22

Mathematical Handwriting Recognition



Directions in Teaching

- Joint program in Computing and Law BSc/LLB
- Western 1st year Faculty of Science 2011-12 400 BSc, 1000 BMSc
 ⇒ Entry-level course in "Medical Computing"

Scorecard

- Just right: Maple, SNAP, MathML, Descartes
- Too early: Axiom/Aldor
- Too late: ??

• Jury out: $x^{n(n+1)/2}$, Math HR, Joint programs

Henry P. Davis

line of sight is moving ahead of the object all during the time it Henry P, Davis In any form of wing shooting, whether the targets be upland game birds, waterfowl or trap or skeet shooting "clay saucers," up a lead which you don't even henry bound in the proceeding the saucers of the short H is the precedent to the short H is the saucers of a prime requisite for good marks-know about. It isn't being record-manship is the ability to deter-mine instantly the proper lead for ou are leading the object more being record-et on your conscious mind. But each individual shot.

ever, after he makes a few hits, problem. this feeling of incompetence passes to some degree and the first

than you think you are How much? No one can tell you that; than you trink you not that; The average novice gunner much? No one can tell you that; when first confronted with this problem, usually weighs his own find the distance which you should find the distance which you should and the distance winds and experience and considers the task almost in-a bit, that's the right amount possible of accomplishment. How- for you, You alone can solve, the How do you allow for different

speeds and different angles" The

the source degree and the first species and different angles. The cardinal rule in shouting effect time high a different angles. The more ple self-evidence speaks for it active the angle, the faster the self. You can't hit 'em if 'ou speed; the more your gun swings shout behind em.' if the faster the the speed of the target. It, the faster the object when you pass. Given the speed of the target, the faster your gun, will be going locity of the shot charge, one well when it takes you to get the time out the exact lead necessary to it takes you to get the trigger teneration in the target that the target the the target and the speed in mathematics can figure the feature in the reaction interval the time out the exact lead necessary to it takes you to get the trigger time his mential shele-rule has more on a fast, acute angle shot dished up the answer, the target the on a slower one at a lesser dished up the answer, the target than on a slower one at a lesser has usually flown on to safer angle. Your swing is turnishing

has usually hown on to safer angle Your swing is furthshing bounds. So the good shot learns, comparisation for the speed and by experience to instinctively ap-anyle of the shot without your cessarily, is done very quickly, A load of shot is about 15 feet and very often unconsciously, in long as it flies through the air-the swing-through that is so im-11 you are a hitle too far ahead portant in good shotgun marks-of the object, some of the tail-and be the down, but manship. Here's How

leading a flying object.

Don't hold your gun still and wait experience of, aiming at the lead

flight. 3. Pass it and pull the trig-

Reference of the trigger pulled than it does for the trigger pulled than it does for the to pass it That you must figure load of shot to travel 40 yards. An out by trial and error. When you average reaction interval takes .20

end shot may bite it down, but if you are behind the object, there This is all I can tell you about isn't any doubt about your missing it. If you have hunted many 1. Start your swing behind it. ducks, you have no doubt had the for it to come to you. Journal of a string flying across in 2. Swing with it, following its front of you and killing one of flight.

The Trigger Pull

but by that and error. When you average reaction interval takes .20 clay targets have been run with-ht, you are right. When you miss, of a second to got the load out of the odds are that you didn't pass the gun after your eye says and skeet. It is only because we ones you hit looked to you over a second for the shot to travel the sights Do it again the same 40 yards. Some people are slow-through it that we are able to de-er and some are faster; small shot where the object is going. clay targets have been run with-

Wayi are and some are taster, small snot far to pass it? Because it takes different hu-about one-third of a second from mans different lengths of time to pull a trigger. When we are solver, big shot are faster, but the two figures add up to cally travel about 13 feet while the shot travels its 40 yards. When we are solver, big shot are faster, but the two figures add up to cally travel about 13 feet while the shot travels its 40 yards. When we are solver, but the shot travels 40 yards. When we are solver but the shot travels are shot trigger, you will not consciously shot where the object is going. you swing fast and pull a slow trigger, you will not consciously have to lead as much as the perunit the shot travels 40 yards. When your eye says "Shoot." It memessage has to travel through the shot travels 40 yards. A bird winging 60 miles an have to lead as much as the per-big the message has to travel through hour ar tight angles to your gun a set of nerves to tell a set of is doing 88 feet per second. So, and pulls a quick trigger. I have the muscles have to pull it. Some ing at a spot the bird is going folks have tvice as long as others to cross, your eye would have to folks have tvice as long as others to cross, your eye would have to folks have tvice as long as others to cross, your eye would have to folks have tvice as long as others to cross, your eye would have to but some of them with a slow re-about 30 feet from the crossing point of the bird and the shot in point of the bird and the shot in the same time. Now no one could if any. They just swung through object's path until you pass it, the speed of your gun movement object—you are overtaking it. As sometimes wonder how we ever your line of sight goes by it, the hit anything' Yet, thousands of No one can tell you how far to pass it. That you must figure out by trial and error.

When you miss, the odds are that you didn't pass it far enough.

Remember how the ones you hit looked to you over the sights. Do it again the same way.

Henry P. Davis

line of sight is moving ahead of the object all during the time it In any form of wing shooting, takes you to pull the trigger after whether the targets be upland your eye says "Shoot," In that each individual shot.

and considers the task almost in-a bit, the second second almost in-a bit, the second second second second second second second almost inpossible of accomplishment. How- for you, You alone can solve, the ever, after he makes a few hits, problem. this feeling of incompetence passes to some degree and the first

game birds, waterfowl or trap space of time, you are building or skeet shooting "clay saucers," in a load which you are building or skeet shooling "clay saucers," space of thic, you are branching up a lead which you don't even manship is the ability to determine instantly the proper lead for conscious mind. But - iou are leading the object more than you think you are How much? No one can tell you that; than you trink you not that; The average novice gunner much? No one can tell you that; when first confronted with this problem, usually weighs his own find the distance which you should find the distance which you should

> How do you allow for different speeds and different angles" The

es to some degree and the first cardinal rule in shooting efficient interval different angles." The ency begins to soak in This simi-ple self-evidence speaks for it-self 'Yon can't hit 'em if 'you shout behind em.' Given the speed of the targe, the more your gun swings ahead of the object when you pass fiven the speed of the target. It, the faster the object goes, the the angle of hight and the ve-faster your gun, will be going locity of the shot charge, one well wree, it passes the target. So -in versed in mathematics can firmer the reaction interval the time out the exact lead necessary. To lit rakes you to get the trigger out the exact lead necessar; to it takes you to get the trigger center the target. But by the pulled, your lead is increasing time his mental shde-rule has more on a fast, acute angle shot dished up the answer, the target than on a slower one at a lesser has usually flown on to safer angle Your swing is turnishing bounds. So the good shot learns, comp nation for the speed and

bounds. So the good shot learns, composition for the spectral and by experience to instanctively apply the proper lead. This necessarily, is done very quickly, Λ load of shot is about 15 feet and very often unconsciously, in long as it flies through the arr. It is you are a little too far ahead portant in good shotgun marks- of the object, some of the tail, but it for the it down, but end shot may bite it down, but if you are behind the object, there Here's How This is all I can tell you about isn't any doubt about your missleading a flying object. ing it. If you have hunted many 1. Start your swing behind it. ducks, you have no doubt had the

Don't hold your gun still and wait experience of, aiming at the lead for it to come to you. 2. Swing with it, following its front of you and kulling one of flight.

3. Pass it and pull the trig-

manship.

out by trial and error. When you average reaction interval takes .20

The Trigger Pull

ger No one can tell you how far trigger pulled than it does for the to pass it That you must figure load of shot to travel 40 yards. An

ht, you are right. When you niss, of a second to get the load out of the odds are that you didn't pass the gun after your eye says it far enough Remember how the "shoot" as against roughly .15 of start behind the object and swing through the load over a second for the shot to travel clay targets have been run withthrough it that we are able to dethe sights Do it again the same 40 yards. Some people are slow-way!

Wayi Why can't anyone tell you how are slower, big shot are faster, small shot yeop any accuracy in tossing the ware slower, big shot are faster, shot where the object is going. The mile a minute bird will Because it takes different hu-about one-third of a second from the shot travels do yards. Find the shot travels do yards. When your eve cave "Shot" you swing fast and pull a slow When your eve cave "Shot" and wing for mile for mile for the shot travels and pull a slow the shot travels do yards. you swing fast and pull a slow trigger, you will not consciously have to lead as much as the perpull a trigger. Short "A burd winging 60 mules an trigger. you will not consciously "When your eye says "Short" A burd winging 60 mules an have to lead as much as the per-the message has to travel through hour at right angles to your gun have to lead as much as the per-a set of nerves to tell a set of is doing 88 feet per second. So, son who doesn't swing so fast muscles to pull the trigger and if you held your gun sull, point-the muscles have to pull it. Some ing at a spot the bird is going they never led game at all. At

the muscles have to pull it. Some folks have twice as long as others to cross, your eve would have to to get the job done. Don't ask me say "Shot" while the bird was but some of them with a slow re-why. It has been proved. Follow and Pass Target When you start your swing be-hind an object, then follow in the same time. Now no one could object's path until you pass it, even accurately judge a distance the speed of your gun movement of 30 feet at 40 yards on an ob-object--you are overtaking it. As sometimes wonder how we ever your line of sight goes by it, the hit anything' Yet, thousands of flying object.

The Trigger Pull

It takes you longer to get the trigger pulled than it does for the load to travel.

Henry P. Davis

line of sight is moving ahead of the object all during the time it In any form of wing shooting, takes you to pull the trigger after whether the targets be upland your eye says "Shoot," In that game birds, waterfowl or trap or skeet shooting "clay saucers," space of time, you are building up a lead which you don't even or skeet shooling "clay saucers," space of thic, you are branching up a lead which you don't even manship is the ability to determine instantly the proper lead for conscious mind. But - iou are leading the object more each individual shot.

ever, after he makes a few hits, problem. this feeling of incompetence passes to some degree and the first

than you think you are How much? No one can tell you that; than you trink you not that; The average novice gunner much? No one can tell you that; when first confronted with this problem, usually weighs his own find the distance which you should find the distance which you should and the distance winds and experience and considers the task almost in-a bit, that's the right amount possible of accomplishment. How- for you, You alone can solve, the How do you allow for different

speeds and different angles" The

es to some degree and the first cardinal rule in shooting efficient interval different angles." The ency begins to soak in This simi-ple self-evidence speaks for it-self 'Yon can't hit 'em if 'you shout behind em.' Given the speed of the targe, the more your gun swings ahead of the object when you pass fiven the speed of the target. It, the faster the object goes, the the angle of hight and the ve-faster your gun, will be going locity of the shot charge, one well wree, it passes the target. So -in versed in mathematics can firmer the reaction interval the time out the exact lead necessary. To lit rakes you to get the trigger out the exact lead necessar; to it takes you to get the trigger center the target But by the pulled, your lead is increasing time his mental shele-rule has more on a fast, acute angle shot dished up the answer, the target than on a slower one at a lesser has usually flown on to safer angle. Your swing is turnishing bounds. So the good shot learns, comp nsation for the speed and

This is all I can tell you about isn't any doubt about your miss-1. Start your swing behind it. ducks, you have no doubt had the

Don't hold your gun still and wait experience of, aiming at the lead for it to come to you. 2. Swing with it, following its front of you and kulling one of flight. 3. Pass it and pull the trig-

The Trigger Pull

No one can tell you how far trigger pulled than it does for the to pass it That you must figure load of shot to travel 40 yards. An

out by trial and error. When you average reaction interval takes .20 the sights Do it again the same 40 yards. Some people are slow-way!

Here's How

leading a flying object.

manship.

ger

far to pass it?

mans different lengths of time to the time your eye says "shoot" pull a trigger.

bounds. So the good shot learns, composition for the spectral and by experience to instanctively apply the proper lead. This necessarily, is done very quickly, Λ load of shot is about 15 feet and very often unconsciously, in long as it flies through the arr. It is you are a little too far ahead portant in good shotgun marks- of the object, some of the tail, but it for the it down, but end shot may bite it down, but if you are behind the object, there ing it. If you have hunted many

It takes you longer to get the

ht, you ar right. When you miss, of a second to get the load out of the odds are that you didn't pass the gun after your eye says it far enough Remember how the "shoot" as against roughly 15 of start behind the object and swing through the load to you over a second for the shot to travel through it has the to declay targets have been run withthrough it that we are able to de-

Why can't anyone tell you how are slower, big shot are faster; small shot but the two figures add up Because it takes different hu-about one-third of a second from the shot travale it do yarde If the shot travels its 40 yards. If you swing fast and pull a slow trigger, you will not consciously have to lead as much as the perpull a trigger. Short "A burd winging 60 mules an trigger. you will not consciously "When your eye says "Short" A burd winging 60 mules an have to lead as much as the per-the message has to travel through hour at right angles to your gun have to lead as much as the per-a set of nerves to tell a set of is doing 88 feet per second. So, son who doesn't swing so fast muscles to pull the trigger and if you held your gun sull, point-the muscles have to pull it. Some ing at a spot the bird is going they never led game at all. At

the muscles have to pull it. Some folks have twice as long as others to cross, your eve would have to to get the job done. Don't ask me say "Shot" while the bird was but some of them with a slow re-why. It has been proved. Follow and Pass Target When you start your swing be-hind an object, then follow in the same time. Now no one could object's path until you pass it, even accurately judge a distance the speed of your gun movement of 30 feet at 40 yards on an ob-object--you are overtaking it. As sometimes wonder how we ever your line of sight goes by it, the hit anything' Yet, thousands of

... no charts, diagrams or tables of figures will give you the remotest idea of how to hit a flying object which is flying differently on every shot.