From the Top

By Witold Kosmala
PSIA-E Alpine, Level III
K2 Ambassador

HAPPY NEW YEAR to all of our readers! I hope and pray that this will be the best and the most rewarding year for you yet. No matter what situation you are in right now, be thankful because it could be worse. In fact, I have received from one of our readers a note saying: “What is all this about being thankful? I see this phrase in practically every one of your publications. ...” The New Year issue is probably the best time to respond to this person, and perhaps to other readers who just never took time or had desire to write me pertaining to this “being thankful” idea. So, in return, can I ask you a question? If someone gave you one million dollars, just as a gift, would you thank them? How do you feel about receiving the new day this morning? Is it worth a million dollars to you? Can you even put a price tag to it? Shouldn’t you be thankful for this new day? You definitely did not make it yourself. It was given to you to live in. So, be thankful and live out each day to the fullest. Make the most out of it. (Note, I did not say: party.)

Some of you might remember – almost 5 years ago, (it will be 5 on March 4), I had a life-threatening skiing accident. I was not even guaranteed to live the next minute. But, miraculously: I did. Getting so close to leaving this world made me truly realize how fragile the life really is. I am thankful for every day that I am given. I live on borrowed time.

Don’t get me wrong, being thankful does not mean that all the decisions I make are the correct ones. I still have hard time living out my last year’s New Year’s resolutions, so I am not sure whether to make any for the year 2013. How about you? What’s with your resolutions? Do they involve skiing and/or riding? Maybe joining a snow sports organization? Perhaps attending a skiing/riding event, or taking that dreaded certification exam? How about moving out of your comfort zone and trying to reach the next level of performance? Whatever your resolutions are, I hope you will be successful with keeping them. Don’t forget that this month we will have PSIA/AASI events held right here at Sugar Mountain. I encourage you to sign up, even if you do not have to have one this year. We need to show PSIA
organization that we want events held in the South by supporting them through participation. Since January is the official “Learn to Ski & Snowboard Month,” I encourage you to do your part.

Read the motivational article by Peter Howard published on page 22 of the Fall issue of SnowPro by PSIA. Basically, he says: don’t let this just be another season. Among many things that you can do this season to make a step forward are publications of Peak Performance. As you can see, there are a number of very famous coaches supporting our efforts in providing you with this great resource of knowledge. They publish their thoughts on our pages to help everyone that takes time to read our issues. We thank all our past, present, and future authors for supporting our efforts to promote skiing and snowboarding.

I am so excited to present this great issue of Peak Performance to you. However, as I said, contents of previous issues are not delinquent. Hopefully you will travel to my web page that can be found at www.mathsci.appstate.edu/~wak/ and look up previous issues of Peak Performance. They can easily be downloaded from that page. Gordon Carr writes about article indexing in this issue. I am sure you will find it most valuable. Also, please, don’t hesitate to write me at Kosmalaw@bellsouth.net. Remember that our intentions are to promote the snow sports to the best of our abilities, so your ideas are most welcome!

One more thing, our shortest days are upon us. And, before we can put those boards on, we must get there. Most of us commute by car. A note of caution: if you have a great visibility, then most likely drivers going in the opposite direction have sun in their eyes. Watch out for them; they might not see you. Now, go on with reading our outstanding issue.

Main Course

Inside Leg Extension;
A Parallel Leg Transition

By Rick Schnellmann

Inside Leg Extension (ILE) is a specific type of turn transition. A turn transition is the method by which one turn is brought to a conclusion, and a new turn is begun. It is NOT the turn itself, it’s a connector of separate turns. There are many types of turn transitions. Each has specific attributes and shortcomings, and serve specific skiing situations. This is why good skiing involves learning a number of them.

As a transition choice, Inside Leg Extension (ILE) carries some valuable benefits. While it can be used for pivot entry turns, where a big twist of the skis is used to quickly redirect them down the hill for the start of a turn, it provides it’s biggest rewards during arc to arc turns (carved turns with no redirecting during the transition), and smoothly connected steered turns. And surprisingly, it also works very well on the steeps, and in steep powder, as it provides a smoother alternative to aggressive hippidy hoppidy (big extensions and pivots) skiing in that arena.

The sensation ILE provides is of an extremely connected to the snow feeling through the entirety of the transition, and into the start of the new turn. That temporary light feeling under the skis common in other transitions disappears (some call that disconnect the “float”), and it’s replaced with a feeling of being locked onto the snow. This continuous connection with the snow provides a very acute feel (in the feet) for the initiation of
the new turn, and an enhanced ability to fine control the quality and nature of that initiation. Great arc-to-arc turns are born in the quality of their initiation, and ILE allows one to really fine tune that quality.

OK, I’m going to describe ILE in two parts. Part 1 will be a KISS explanation of how it’s done. I’ll attempt to avoid overloading people with details unnecessary to go out on the hill and give it a go. Part 2 will be more details about why it works. Some learners need that info to better digest and apply a technique.

**HOW IT’S DONE:**

I’m going to describe from the perspective of connecting carved turns, but steered turns will follow similar directive. Imagine you’ve just carved a nice turn, and you’re approaching a point where you’d like to bring it to an end. The majority of your weight is on your outside (downhill) ski/foot. Somehow you need to tip your skis off the uphill edges they’re on, and back to flat so the turn you’re making will stop, then tip them to the other side to begin a new turn. Try this: Without moving your pelvis left or right, softly push down on your old inside (uphill) foot. Because that foot is still tipped from the prior turn, you will be actually pushing down on the little toe edge of that ski.

It’s very important to NOT move your hips uphill as you push down on your uphill foot. As you push down you will feel pressure shift from your old outside (downhill) foot to your old inside (uphill) foot. Immediately you will feel your old inside ski, the one you’re pressing down on, begin to roll and flatten, and your body begin to move downhill. The harder you push down on that old inside foot, the faster you will tip into the new turn. It takes very little push down on the uphill foot to get the process going. In fact, it can be so slight as to be almost unnoticeable to observers. Feel the pressure under your uphill foot. If you feel it transferring there very gradually, you’re on your way to a good turn transition.

As you tip down hill, continue to subtly extend your uphill (new outside) leg, and drive your new inside (downhill) hip forward. The continued extension of the uphill (new outside) leg will keep pressure solidly on that new outside ski as it tips onto its downhill (big toe) edge, and the inside hip drive will get you properly forward and countered for the start of the new turn. The inside hip drive while tipping into the new turn is a very important part of the formula. The continuous outside ski pressure is what’s needed to bend the new outside ski to start the new turn. Try to control your rate of tipping so that you very progressively roll onto your new big toe edge. Control it such that you can feel in your foot each small increment of additional edge angle as it occurs. As this turn initiation process is taking place, maintain good balance on your new outside ski. Keep gradually tipping to a higher edge angle till you eventually get to the angle you need to produce the shape turn you want.

If you’re steering your turns, the same push down on uphill foot procedure is done. But when your skis have rolled down to flat on the snow, and the body has tipped downhill to the point it’s directly over the skis, begin your leg steering. From that point follow the procedure for a leg steered turn.

Here’s a good video of what they look like. Focus on the extension of the old inside (uphill) leg to begin the transition. Pay particular attention to Guay and Nyberg. Their execution is superb.

http://www.youtube.com/watch?v=TTboYL8CjaU&NR=1

**WHY IT WORKS:**

It’s all about management of turn forces and balance. When you make a turn, you have to deal with 2 primary forces, gravity and momentum. Gravity pushes you down, momentum pushes you toward the outside of the turn. Those two forces combine to produce what acts as a single “resultant force”, which pushes you towards the snow at an angle somewhere between straight down (gravity) and straight to the outside of the turn (momentum), that exact angle dependent on amount of momentum present in each individual turn.

It’s that resultant force we need to cope with to maintain balance as we ski. If we line up our Center of Mass (CM) in such a manner that the resultant force acting on our CM is directed right at our outside foot, that is where our balance will reside. If we move our Center of Mass (CM) laterally further inside our feet, our balance point moves closer to our inside foot. If we move our CM too far toward the inside of the turn, our balance point moves inside of our inside foot and we fall down. If we move our CM too far toward the outside of the turn, our
balance point moves outside of our outside foot and we topple over. Make sense? As long as we keep our CM located laterally such that the resultant force acting on it lines up somewhere at or between our feet, we remain in some form of balance and upright. As soon as it moves outside that base of support, we become out of balance and fall down.

OK, so here’s how ILE works. When we’re turning while balanced on the outside foot the resultant force is directed at that outside foot. When we push down on the inside foot, we’re removing our outside foot from our base of support. We have nothing to balance on, so we topple over. That toppling rolls us off our uphill edges, and brings our prior turn to an end.

This only works if we don’t move our CM uphill. If we move the CM uphill we move our balance point toward the inside foot, so balance is not lost, because we still have that foot to balance on. We simply continue turning, balanced on that uphill foot. To make the topple happen, the CM can’t move uphill.

How hard you push on the uphill foot controls how fast you topple into the new turn. It does so by controlling how fast and much pressure transfers. The more pressure that’s transferred to the uphill foot, the faster you topple, because the more outside foot support you’ve taken away. This is a good control mechanism to use to manage how fast you want to transition into your new turn. For learning, start out pushing softly, and transitioning slowly. Get the feel of it, develop the fine control of the initiation, then later try speeding it up as desired.

The inside hip drive is an integral part of ILE. As you push down on the old inside (uphill) foot, and your Center of Mass (CM) begins to automatically move downhill, drive your new inside (downhill) hip forward. This move does a few very important things. First, it pronates the outside foot. Pronating that foot directs pressure to the big toe side of the foot, exactly where you want the pressure to be to best engage the turning edge of that ski. Second, it moves weight from the heel of the new outside (uphill) foot, to the front. Again, right where we want it for the start of the new turn. Third, it eliminates the counter of the prior turn, and establishes the counter needed in the new turn.

The basis of this inside hip drive is something called gait mechanics. Basically what we are doing when we make this inside hip drive is mimicking what we do when we walk. When we walk we stride out to take a step and land on the heel of our lead foot (let’s call it the stance foot). As we land, the stance foot naturally rolls into a supinated (pressure on little toe side) position. While in that position, the pelvis is countered away from the stance foot, and the rearward foot we are striding off (soon to be the swing foot) is pronated. At this point in the process we are in a position that simulates our position at the end of a turn: pelvis countered, outside foot pronated, inside foot somewhat leading and supinated.

As we continue with the step sequence, we move our swing foot forward, our weight moves forward on the stance foot, and the pelvis loses it’s counter. As the weight moves forward on the stance foot, that foot begins to roll away from supinated and toward a more neutral state of lateral pressure. This position now simulates a skier at neutral during a turn transition, when the skis are flat on the snow, and the pelvis has rotated back to square with the skis.

To complete the step sequence, the step continues. The swing foot moves ahead of the stance foot. The weight on the stance foot moves to the front. The pelvis counters away from the swing foot and towards the stance foot. The countering of the pelvis, and the movement of weight to the front of the stance foot causes that foot to leave roll from neutral into a state of pronation. This point in the walking sequence simulates a skier’s position at the beginning of a turn, where the new outside foot is pronated and fore pressured, and the pelvis is countered.

So this is what the inside hip drive does, it uses the
principles of gait mechanics to produce the forward pressure, pronation, and counter we need to produce a high quality turn initiation.

Rick Schnellmann was a long time race coach who produced countless FIS level athletes. He’s now shifted his focus to helping recreational skiers develop the same fundamental skills that all the best racers in the world use to achieve their success. Rick has produced a series of instructional DVD’s that sell around the world, conducts on snow camps, and operates the Skier Village online community. Find his instructional products at www.YourSkiCoach.com, and drop in to chat with him at www.SkierVillage.com.

Index for Improvement

By Gordon Carr
PSIA-E Alpine, Level II

The Peak Performance editions, now totaling 36, have become a resource of real value to help us improve our skiing, riding and teaching performance. I know Witold has had numerous favorable comments from around the country about the tips for becoming more proficient in riding, skiing, teaching, class handling, fitness, and other aspects of snow sports. For last month’s article, I had occasion to root around into the archives to locate a photo and some other information, and I spent a LOT of time getting side-tracked! I would come across a “forgotten gem”, spend many an evening re-reading articles, and wonder how could I have “missed this nugget of wisdom” on first read. With real shock, however, I also realized how incredibly difficult it was to locate a specific article about a specific topic of interest! What creates this search challenge is that the Peak Performance is so jammed full of great information and tips representing many aggregate “instructor-years” of knowledge. The problem is compounded because even if you get to the correct edition, the article titles don’t always accurately reflect article content (I’m probably the worst offender in that regard).

So what I thought was, we need a “Topical Index” of all previous editions, which either can be printed out and saved, or separately posted on Witold’s web site so that instructors can quickly and easily access a specific topic and refresh their memories. There are now 36 editions, perhaps 600 pages of information, which is a volume impossible to re-read when you only want to review e.g. teaching Spontaneous Christies. Once this Index is published, I will periodically update it, probably annually, and then we will have more easily accessible knowledge in this format about our snow sport.

Print out the full INDEX which will be separately published next month in the February, 2013 Peak Performance… you will be glad you did. In this edition, January 2013, we wanted to publish an INDEX of Peak Performance articles which might be helpful to our new snow sport instructor colleagues. There is a lot of great information about teaching beginners, class handling, safety, etc. but is not easily accessible, who would ever search around for it. So later in this edition is “The New Instructor INDEX”. I learned a lot from researching and re-reading all the articles… perhaps others will find it helpful for our work especially with the beginner skiing and riding guest. It was with some chagrin that I realized the best knowledge available, if just stuffed in shoeboxes and put in the attic, is useless. Knowledge must be retrievable. Isn’t that a brilliant insight… where have I been these last four years? DUH!

An important caveat: first and foremost, the Peak Performance articles are not a substitute for official policies, procedures or protocols published by Sugar Mountain Ski and Snowboard School. These articles are meant to be a compilation of helpful information to be used when concordant with official policies. A second disclaimer: I have tried to abstract the fundamental principle of articles so that the index is “topical” and not listed just by title. I have also wielded an editorial knife; some of the funny stuff, the want ads, outdated travel offers, perhaps even some of the cross training articles went by the way-side. If I have offended anyone, I apologize. All the material
in each edition has been really valuable and interesting to me when first published. But for the Index, I wanted to focus primarily on skiing and riding tips and fundamentals of teaching our winter sport. Information about conditioning, cross training, lateral learning, safety, and of course articles from our Director, Len, covering Ski and Snowboard School expectations of instructor professional conduct also seemed important for the Index. If anyone believes I have omitted something really important, please email me and I will make the addition at the next update. (gordoncarr@charter.net) The information and knowledge is from all of you… the errors of abstraction are mine.

To repeat, I have separately listed an index in this edition of the Peak Performance, which may be of particular interest to people new to snow sport instruction. Again, I have made the selection of articles; others may have composed a different list of topics. I have included the comments from our Director, Len, on how to be a more professional instructor, basics on teaching beginning classes and first turns, and some basics about feedback, learning stages and class handling, and several articles on building that critical, but illusive, relationship quality called, “trust”. I hope all new instructors will take the time to review all topics they are interested in from the full Index, but I do believe the “New Instructor Index” may help reduce the initial overload of “Help!! What should I do when…?” By-the-way, all you new instructors, take a moment and write your thoughts and ideas about becoming a snow sport instructor… tell us how we other instructors have assisted (or NOT) your journey into this glorious white world. We all would love to hear your perspective. Submit something to Witold for publication! Kosmalaw@bellsouth.net.

I can confidently say that if you hired private lessons for personal skiing or riding improvement, or paid a mentor/tutor instructor to shadow you during your instruction for purposes of your teaching improvement, it would cost a small fortune to get the knowledge and tips contained in Witold’s inspiration and creation! Thanks Witold!

Finally, remember these articles and the information contained therein are reference materials to be used again and again. Use the Index! Each time I read an article I seem to come away with a new and different insight. But, remember, the material is NOT Sugar Mountain or Sugar Mountain Ski and Snowboard School official policy.

THE FULL INDEX NEXT MONTH

Just Another Day in the Office

The photos below are with complements of Scott Marland, brother of Eric whose poem we published in our last issue of Peak Performance. I don’t know what is with these brothers, but they are both Ph.D.’s with passionate love for skiing, among many other things. Scott is the Assistant National Chairman of the National Ski Patrol System, www.nsp.org. His ski-patrolling career actually started at Ober Gatlinburg, TN when he was 15 years old. Now Scott is at Brighton, UT. You can meet Scott in the video found at https://vimeo.com/35812911. Scott is teasing us with wonderful photos, but life of a patroller has many sides to it. I have a great respect for all patrollers. At one time, they saved my life. Scott, thank you for sharing your love for the sport with us.
Cross-Training

Tightroping

By Witold Kosmala
PSIA-E Alpine, Level III

In the July issue of Peak Performance we commented on Philippe Petit’s walk on a cable between the 2 towers in New York City in 1974. Philippe Petit is a French high-wire artist; but not the only one that thrives on the adrenaline which that sport offers. Tightroping is definitely a very demanding sport. It requires unbelievable balance, physical and mental strength, concentration, bravery, and life insurance, among other things.

Here is a photo of Freddy Nock from Switzerland walking on the ropeway of a cable car. He is walking down from the top station at the altitude of 10,836 feet to the mid-station of 8,865 feet. I suspect that walking down would be harder then up since more time is spend on the heel which is not as flexible as the ball of the foot. Freddy used balancing pole for his trip down. Hopefully the near-by helicopter did not cause too much air turbulence.

In the second photo on August 20, 2011, we have Freddy Nock again. This time he is walking up the two-inch-thick cable without a balancing pole and no safety measures. He was walking up the ropeway of a cable car leading on Germany’s highest mountain Zugspitze with elevation of 9,718 feet. What’s with this guy, can’t he buy a cable car ticket? Don’t you wonder what goes through his mind as he takes his 90-minute long unusual walk?
I hate to disappoint you, but I have never done tightroping of much caliber, but to me the lateral learning for skiers and snowboarders is obvious. Tightroping:

- develops lateral balance.
- develops nerves of steel.
- develops fear management like no other.
- develops concentration.
- develops leg strength, that of the feet in particular.
- develops cardiovascular efficiency.

I would recommend starting your tightrope-training with something little closer to the ground. Higher up you go, higher your life insurance ought to be. And, when you climb up or down the cable car rope, look out for icy places on the rope. You are doing it at your own risk!!!

# Training

## Peak Performance Index

for New Instructors

*By Gordon Carr*

*PSIA-E Alpine, Level II*

All editions available at [www.mathsci.appstate.edu/~wak](http://www.mathsci.appstate.edu/~wak).

REMEMBER THE TWO RULES:

1. For Kids, if it isn’t FUN, it isn’t worth doing!
2. Adults are just BIG KIDS, refer to Rule #1.

WORDS FROM OUR DIRECTOR

**DECEMBER 2009**

Fundamental Ski and Snowboard School Rules

**APRIL 2010**

Words From Our Director

**DECEMBER 2011**

Tips From Our Director on Being “Professional” and Creating Successful Lessons

**DECEMBER 2012**

Our Director’s Tips For Being an Effective Snow Sport Instructor

SAFETY

**DECEMBER 2010**

Teaching Guests Skills Comes After Assuring Their Safety

**NOVEMBER 2009**

Your Responsibility Code

Peak Performance
MARCH 2010
Save That Anterior Cruciate Ligament (ACL)

APRIL 2010
More Tips to Avoid ACL Injury

TEACHING THE BASICS
FEBRUARY 2009
Teaching the First Turn

NOVEMBER 2009
Basic Tips For Teaching Beginners

DECEMBER 2011
Ski Lesson 101: Fundamentals

DECEMBER 2009
Teaching Tips: The Turning Wedge, The Beginnings

DECEMBER 2011
Teaching Tips: Wedge Christies, Spontaneous Christies, Narrow Wedge and Braking Wedge

JANUARY 2010
Teaching Tips: Wedge Christie Turns

FEBRUARY 2011
Instructions For Loading a Chair

NOVEMBER 2009
Tips For Gripping Poles

MARCH 2009
Hand And Pole Position

SEPTEMBER 2009
Use The Clock to Help Complete The Turn

TRUST
OCTOBER 2010
Build Trust as The Foundation for Skill Development

Guaranteed Ways to Erode Trust

JULY 2010
Building Trusting Relationships: The JoHari Window

CLASS HANDLING
FEBRUARY 2009
Lesson Planning: ICGIAS…Introduction, Coaching, Guided Practice, Independent Practice, Assessment, Summary
Race Clinic

Ted Ligety’s Technique Explained

By Harald Harb

Here are examples of what Ted is doing that fit right into what we teach in PMTS (Primary Movements Teaching System) Direct Parallel.

- Counter-acting: His inside hand and shoulder are leading the arc. His torso is counter acting.
- Counter balancing: His upper body is laterally balanced reducing inclination.
- Flexing and extension: Inside leg totally flexed and bent. Outside leg long and solidly aligned.
- Fore/aft: His hips are forward of his boots earlier and higher in the arc, without using an extension or up move of the hips.

Many can see that the outside leg is long, but that’s not the issue, the issue is how does one get into this movement pattern. It’s not a position! The only way to learn to ski this way is to know what movements are being used to create this kind of skiing. Few know the movements. We teach these movements in our PMTS system.

Everyone who watches the world cup knows Ted Ligety is dominating GS. The second GS race of the year was closer, under 2 seconds, but still a huge margin.

So what is Ted doing the others are not?

Well, first he's doing what I have been advocating for years, his stance is much narrower in transition than last
year. I saw this happening in his training earlier this season before the WC season started. He then collapses his inside leg more quickly then any of his competitors. This means his inside leg is tipping and flexing really quickly, into the apex or belly of the arc, which drops his hips to the snow at the precise moment to gain huge angles. These perfectly timed movements engage his skis and create instant pressure and a shorter, stronger radius than the rest of the GS racers.

OK, that said it sounds easy, but if it were everyone would do it. Ted has practiced this for months and has focused on these details. He may not even realize what he is doing, but he has the sense of timing and angle creation that no one else has. Eventually the others will figure it out, but for now he still has the movements that give him the advantage and amazing confidence that his equipment will keep him up when he makes those incredible movements.

Check out his narrow stance, this is as close as I could find a photo, in transition, before pressure is loaded. This is a Super G photo, so notice the difference in stance the last few years. The racers are going to narrow up their stance, even more and use inside ski and leg tipping and flexing more precisely, then before.

Harald Harb is President of Harb Ski Systems. Born in Austria, he moved to eastern Canada at an early age. Harald has World Cup racing experience with the Canadian National Ski Team, and later was the Overall Pro Champion on the Eastern Regional Circuit. He then started to coach racers and directed racing programs. Harald directed and coached programs that produced some of the USA's most successful National Team members and Olympic medalists. Harald achieved the highest credentials in both the USSA racing organization as a Master Coach and the PSIA Professional Ski Instructors of America as an Examiner and National Demo Team Member. After coaching for 20 years, Harald spent four years on the National Demonstration Team. Working with recreational skiers, he was convinced that current teaching systems needed improvement. Harald created the Primary Movements Teaching System™ (now known as Direct Parallel®) and the Harb Skier Alignment System™ so that skiers could learn to ski quickly and easily. Harald’s Blog can be found on: http://harbskiysystems.blogspot.com/.

Comma Turns

By Witold Kosmala
PSIA-E Alpine, Level III

Ski racing involves latest technology under every respect. This includes the most appropriate skis with innovational wax; best bindings and boots; slick and aerodynamic clothing, helmet and poles; best physically fit athlete with nerves of steel; most accurate timing devices; and so on. There is a constant research going on how to make racers faster pertaining to providing them with best equipment, best training log, and best techniques and tactics. All these things change all the time. Take for example, new FIS giant slalom dramatic ski restrictions for this winter. But, there is at least one thing that does not change – for centuries, in fact. And that is: the fastest
path from point A on the snow to point B down the hill, but not directly below the point A. This path, known to
many as Brachistochrone, has been found in 1697 by a great Swiss mathematician Johann Bernoulli. All quality
racers and coaches know what these fast lines are and try to utilize them in the races as much as physically
possible.

If you are mathematically inclined (and I know that many of our readers are,) you can continue to read below an
outline of how to go about finding such fast line in the simplest possible case, that’s when only gravity acts on
the skier. If other factors are also involved, like snow and air resistance, the path stays basically the same but
mathematically given by a much more difficult formula. Of course, if the mathematics behind developing the
fastest path from point A to point B does not interest you, skip toward the end of the article to find out what this
curve actually is and read some final comments.

So, we get the show on the road by performing the following task. We take a circle of radius \(a\) and mark a point
\(P\) on its circumference. Now, “roll” the circle along a horizontal line without slipping, while tracing the curve
that the point \(P\) produces. See the illustration below.

The resulting curve from one cusp to the next is called a cycloid, the term given for it by Galileo in 1599. Next,
we will quickly derive parametric equations for cycloid. This will be important as we seek that fastest line of
descent that we were talking about earlier.

According to the illustration above, let the circle of center \(Q\) and radius \(a\) roll along the \(x\)-axis beginning with \(P\)
at the origin. A parameter \(t\) may be chosen to be the radian measure of the angle \(AQP\), where \(A\) is where the
circle touches the \(x\)-axis. Since the circle rolls without slipping, the arc \(AP\) has the same length as the line
segment \(OA\). Therefore, \(at\) is the same as \(d(0, A)\). Also, the \(x\)-coordinate of the point \(P\) is given by

\[
d(0, B) = d(0, A) - d(A, B) = at - a \sin t = a(t - \sin t).
\]

In a similar way we get the \(y\)-coordinate of the point \(P\) to be given by

\[
d(B, P) = d(A, Q) - d(Q, D) = a - a \cos t = a(1 - \cos t).
\]

Thus, the parametric equations for the cycloid are

\[
x(t) = a(t - \sin t) \quad \text{and} \quad y(t) = a(1 - \cos t).
\]

Are you still with me? If so, read on.

If in the parameterization above, the value of \(a\) is negative, then the resulting curve will be called an inverted
cycloid. The resulting curve is the above cycloid with the exception that the circle of radius \(|a|\) rolls below the \(x\)-
axis. The first half of the inverted cycloid plays an important role in physics and in SKIING. In fact, a skier that
follows this curve will get from the point \(A(0,0)\) to the point \(B(x_1,y_1)\) quicker then a skier following any other
line. In fact, below, I will give you an outline of steps you can take to prove that this is indeed the quickest line.

1. By considering the kinetic and potential energy of the skier at a point \(P(x,y)\) between \(A \) and \(B\), show
   that \(v^2 = 2gy\), with \(v\) being the velocity of the skier.
2. If \(s(t)\) is distance traveled along the curve at time \(t\), then \(v = ds/dt\). Conclude that \(ds/dt = \sqrt{2fy}\).

Peak Performance
3. Write the time it takes the skier to travel from $A$ to $B$ as
$$\text{time} = \int_0^{x_1} dt = \int_0^{x_1} \frac{1}{v} ds .$$

4. Since $ds = \sqrt{1 + (y')^2} \, dx$, show that
$$\text{time} = \int_0^{x_1} \frac{\sqrt{1 + (y')^2}}{\sqrt{2gy}} \, dx .$$

5. For the brachistochrone problem, we want to use $y(0) = 0 \, , \, y(x_1) = y_1$ and $f(x,y,y') = \frac{\sqrt{1 + (y')^2}}{\sqrt{2gy}}$. Use Euler’s equation and some algebraic manipulations to show that $y$ is a solution of the differential equation
$$y\left[1 + (y')^2\right] = K \, , \text{for some constant } K .$$

6. Show that $\sqrt{\frac{y}{K - y}} \, dy = dx$.

7. To solve for $y$, let $\sqrt{\frac{y}{K - y}} = \tan \phi$ and show that
$$dy = 2K \sin \phi \cos \phi d\phi \quad \text{and} \quad dx = \tan \phi dy = 2K \sin^2 \phi d\phi = K[1 - \cos(2\phi)] d\phi .$$

8. Show that $x = \frac{1}{2} K[2\phi - \sin(2\phi)] + c_1$ with $c_1 = 0$.

9. Let $t = 2\phi$ to show that $x = \alpha(t - \sin t)$ and $y = \alpha(1 - \cos t)$, where $\alpha$ must be chosen so that the curve passes through the point $B$. Observe that this parameterized curve is half an arc of a cycloid. This curve looks like nothing other then a comma which is graphed below.

This is why the comma turns are utilized so much in racing is now obvious, as well as late apex, which was discussed at length in the December issue of *Peak Performance*. However, getting from one comma to the next is a very different story. I will write on this in our next issue of *Peak Performance*. After all, these comma turns need to be connected somehow, and so do our articles.

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### From Cars to Skis

#### Sound Systems

*By Witold Kosmala*

*PSIA-E Alpine, Level III*

There is an amazing connection between driving a car and skiing. They both turn in front, they both have outside and inside wheels/edges, they both go on a surface, they both accelerate and slow down, they make turns, they slip and slide, oversteer, understeer, and so on. And, you can race them both. But for some reason people can relate to driving a car much easier then to skiing. So, I thought that for a few issues of *Peak Performance* I will bring up different things about cars that can translate directly to skiing. In the previous issues we briefly
discussed smoothness, oversteering, understeering, tires and racing lines with late apex. In this issue we will briefly talk about playing the sound system in your car.

Isn’t music so wonderful? We could just listen to it nonstop. In our cars we have perfect set-ups of speakers to produce a perfect reproduction of a perfect audio performance. We can play all sorts of music to fit any mood or desire. We can play it loud, or we can play it soft. We can use headphones or entertain everyone that is inside the car. We can use music to make your eyes water so we cannot see the road, we can use music so we cannot hear emergency vehicles approaching, we can use music to get so deep into it that we are practically hypnotized. We can use music so we can dream and fantazise. We can use music to calm down or to get all angry and excited. We can use music to lower our heartbeat or to raise it. We can use music to block out kids’ back seat noises. We can use music to block out the traffic noise around us. We can use music to take all our attention from driving when we look for just the right CD to play, or when we drop one between the seats or on the floor. We can use music to argue over with other passengers as to which CD goes into the player. We can use music to forget what it is we are doing all together. Music has just so much power! There are even extensive studies done on music therapy.

As suggested in above paragraph, there are benefits to driving in a quiet as well. Didn’t lack of music ever help you in driving when rain changes to ice? If you hear splash, then all is fine. If splash disappears, then expect frozen water on the road.

Can you translate all this into skiing? Now-a-days helmets come equipped with complete audio systems. They can do for you everything that a car system can do for you that I mentioned above. But, inside your helmet there is no one else to please, so you can please yourself by listening to whatever you want to. You can be selfish for a change. In fact, you can cut in front of others because you don’t hear them coming. You can put yourself in any mood you want to. You can hypnotize yourself and just ride without even thinking. BUT, there are some great benefits when skiing or riding in a quiet. You can listen to the sounds your boards make. You can judge your technical performance from these sounds alone, especially when you know what you should be listening for. You can listen to the sound ski poles make when planted and when dragged on the snow behind you. Your skiing technique can greatly benefit from hearing these sounds. Of course, safety is also greatly improved when you can hear others around you. In the quiet you can focus on what it is that you are doing so you do not keep reinforcing those bad habits by repeating them over and over again by just skiing/riding. So many of us want to be left alone. We block ourselves in our own world, don’t want to be talked to or corrected. But, just think how much more fun our sport can be if we were better at it. In fact, quiet is good for our soul as well. It is healthy not to be constantly bombarded with sounds, which we sometimes call music and sometimes we call it noise. Perhaps we might hear chirping of a bird, shimmer of a stream, crackling of broken icicles. Perhaps we will hear the wind, the running of a chairlift, roar of the snow making machines, squealing sound of a snowmobile, snow scrapings by other riders ... and be part of it all. Instead of being all removed, all alone, all surrounded by whatever it is that we are playing in our helmets. I suggest; if you came to ski – then do just that: SKI.

Turn to Wisdom

• What you tolerate in yourself, you will not change.
• Both optimists and pessimists contribute to our society. The optimist invents the airplane and the pessimist the parachute.
• Winners never quit and quitters never win.
• Education is the most powerful weapon you can use to change the world.

Thoughts for the Month

• What are you known for? What do people say behind your back? Are you kind and gentle? Are you fun to be with?

Peak Performance
• How should the proper ski pole length be determined?
• What is meant by NASTAR in recreational skiing and snowboarding?
• What are the “stivet” turns?
• In view of car and/or ski racing, is there such a thing as double apex?

Elaborations on last month’s Thoughts for the Month.

Question: What are the “comma” turns and what are they commonly used for?

Answer: See the article on 13 in the publication.

Question: Why was the first “shaped” ski in the early 1990’s called parabolic, and why are they not called this way any more?

Answer: Parabolic skis were first developed in 1988 by Slovenian ski company Elan. These skis had a deep side cut so that making carved turns was possible at slow speeds and with short turn radius. The shape of the skis’ edge was indeed parabolic (which is a mathematical term for that particular curve that was used.) The original Elan project was called SideCut Extreme, or SCX for short. See the photo. These pictured skis were my brother’s, and I had a pair just like them. Their torsional tension grew weak relatively quickly and wide tails would easily catch with poor technique. But, none-the-less, when these skis hit the ski shops in 1993, they were a revelation. Other companies quickly started producing their own models of narrow-waisted skis. In order for these type of skis to be skier-friendly and forgiving, the tails were made narrower then the tips. This resulted with different side-cut geometry, and so they could not be called parabolic any more. The new term of “shaped skis” was introduced.

Question: You are on a very firm snow. Slope is empty, clear and smooth. Only gravity is acting on you when you are skiing down. You are standing at the point A on the slope and want to get to the point B down the slope, where B is not directly below A. Will a straight line get you there the quickest?

Answer: NO. A straight line is the shortest line, but not the quickest. Just like driving on the inside of a turn gives you the shortest path around the corner, but not the fastest. (See the “Racing Line” in the December issue of Peak Performance.) For the quickest path between 2 points see the article on 13 in the publication.

This and That

50th SEASON

Here is a partial list of resorts that are celebrating their 50th winter season:

Anthony Lakes, OR
Appalachian Ski Mountain, NC
Breckenridge, CO
Crystal Mtn., WA
Jay Peak, VT
King Pine, NH
Mad River Mtn., OH
I am enjoying the Alpine Slide at Ober Gatlinburg this last summer. Who says it is only for the kids? The hardest thing for me was to get on that “sled.” After that, it was all down hill.

Pet of the Month

Frieda Carolina’s favorite pets (Gordon and Caroline Carr.) She almost has them house broken. Sit! Stay!

Picture Citations:
- http://www.worldrecordacademy.com/stunts/img/112094-highest_cable_wire_walk_Freddy_Nock.jpg