

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically. While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

An Introduction to Charting Volleyball Matches

L. Ravi Narasimhan
oski@physics.ucla.edu
<http://www.physics.ucla.edu/~oski>
Los Angeles, California
Version 2
December 1996

Note: This document is made available under the terms and disclaimers set forth in the "Caveats" section at the end.

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

Introduction:

Anyone who has attended an indoor volleyball match will have noticed coaches, assistants, and even players jotting notes furiously on clipboards throughout a match. Volleyball has had a long love affair with numbers, diagrams, statistics, and trends. The people on the sidelines are, most likely, taking charts of the match in progress. And when they are not playing, they are probably scouting their competition. The result is pages of colorful notes on hitter tendencies, passing rankings, and blocking effectiveness, just to name a few.

Charting is important, high-level teams all do it. Charting is also a lot of fun, any fan can do it. The sheer volume of data in a completed chart can be intimidating at first glance. This, however, is very misleading. There are a few simple steps which, when repeated in a logical and consistent manner, yield beautiful, complete charts by the end of a match. In this tutorial, I hope to show how I go about charting an indoor match in six easy rotations.

Who should go through the effort?:

- Any fan interested in trying to reverse-engineer a coach's thinking process
- Any fan who wants to remember how a game unfolded
- Any fan who wants to be able to keep his/her own record of a match for comparison with those of others
- Any fan who enjoys volleyball but wonders afterward who got hot, who went cold, when the momentum shifted and to whom, and what, if anything, did the teams do about it

The Six Rotations:

The pregame orientation

R1: Learn the sets

R2: Find those hitters

R3: Serve, receive, and the first attack

R4: The transition to transition

R5: Shorthand notation of plays

R6: Who gets it, who gives it up? Tracking scoring and taking notes.

The postgame analysis

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

The Pregame Warmup:

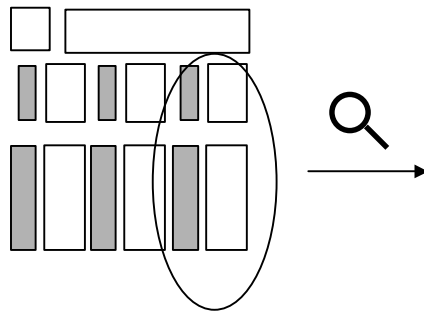
A chart is a piece of paper with one or more rectangles that symbolize volleyball courts and room to take notes. For those with access to the Internet, I have a number of examples on my Volleyball page. The URL is <http://www.physics.ucla.edu/~oski/vball.html>. Feel free to take a look at some of these charts before proceeding further. If you obtained this document from that website, you should have a separate file with a blank chart and an annotated fragment.

The chart blank I use consists of six courts in two rows of three. Here is a roadmap to one of the columns:

The bottom court contains diagrams of what plays a team runs in a particular serve-receive rotation. The top court contains the diagrams for the plays that team runs in transition (when the team serves or any play after the team receives serve and completes its first attack.)

In this scheme, each column represents a rotation. Three rotations per page requires that two sheets be used for a match. And that's the most important part of this charting scheme.

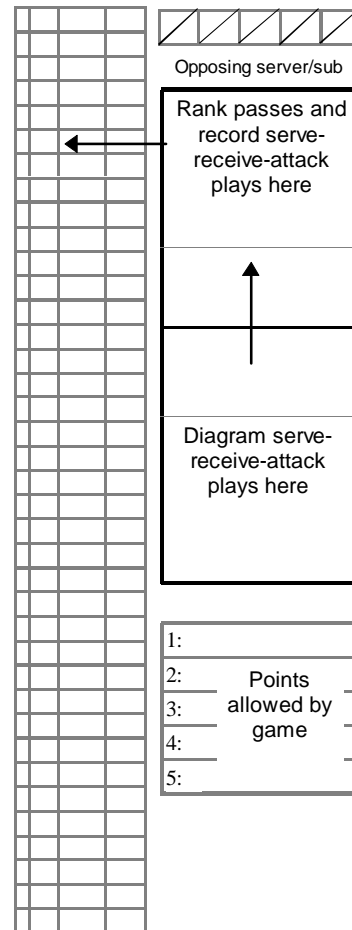
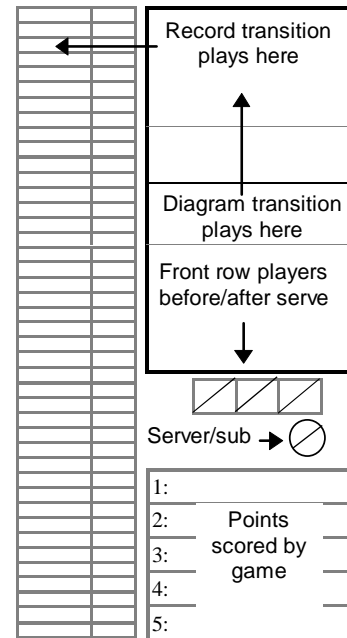
The rest of the spaces are to record relevant information about the match. The tables on the left will contain a shorthand notation of what plays a team ran (Rotation 5 in the tutorial.) I use the three squares underneath the top court to write the jersey numbers of the front row players so that I can identify them for serve-receive purposes (Rotation 2.) Above the bottom court are five squares. Here we keep track of the opposing server, one square per game. This way we can figure out later if the opposing team shifted alignments based on match events (Rotation 6.) Finally, we can keep track of which points were scored and allowed in which rotation in the spaces so indicated.



Definitions:

S/R/A - Serve/Receive/Attack: Whenever a team receives serve and its first attack based on that reception.

Transition - All other plays. The attacks a team makes when it is serving and digs a ball, or, when a team receives serve, doesn't terminate, and the rally continues.



May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

Rotation 1: Learn the sets

This crude sketch indicates the sets that one normally encounters in indoor volleyball. It is not exhaustive, nor is it drawn to scale. There is neither rhyme nor reason for most of the names, there are other conventions in use as well. The dog is the famous Irish setter, Rusty O'Rvorak.

There are three broad classes of left side sets:

Hut: A fast ball relatively low to the top of the net, also called a flare.

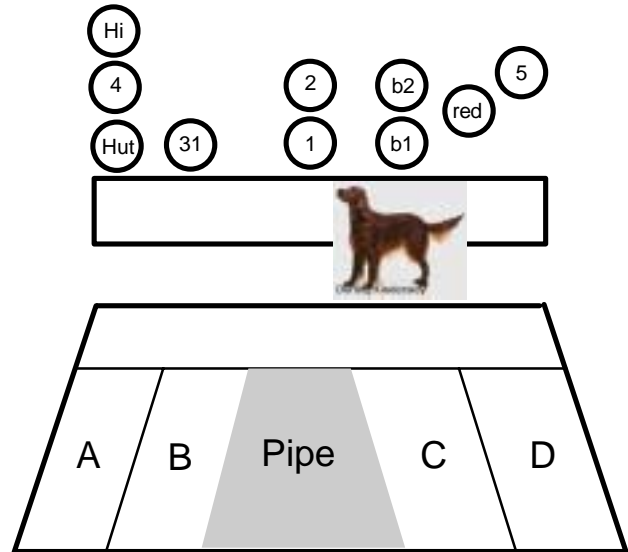
4: Higher trajectory than a hut

High (abbr. Hi or h): A ball pushed up in a high-arching lob. This can indicate a desperation move on a bad pass, for example. There are, however, hitters who like a very high ball as a matter of course. Tee Williams of the USA Women's National Team is a notable example.

On the flip side, the right-side hitter usually has two options:

5: This is the rightside analog of a 4.

Red: A quick backset, somewhat lower than the 5. The lore is that this was the favorite set of Steve Timmons, he of the flaming red hair. And hence its name.



The backrow attack is now one of the staples of the men's game. No longer is the 10 foot (3 meter) line any impediment to the high-flying redwoods playing high-level volleyball. The most common sets out of the backrow are the

Pipe and the **D**. The **A** set, from the leftside of the court, is becoming more popular. Women's teams are experimenting with backrow attacks more and I hope that their offenses diversify as the caliber of athlete gets better with time.

For my money, the best matches are those that involve at least one aggressive setter. These are the players that will set the middle attack on bad passes as well as good. Watching the precise timing between a setter and his quick hitter is, for me, one of the true pleasures of volleyball.

The most common middle sets are:

Front 1 or 1: A short ball in the center of the court and in front of the setter.

Front 2 or 2: A ball about 1 to 1.5 meters above the net in the middle.

Back 1 or b1: The same as a 1, only the middle hitter goes behind the setter.

Back 2 or b2: The same as a 2, only the middle hitter goes behind the setter.

31 or shoot: Here, the ball travels about the same height, but, is pushed along the net away somewhere between the middle of the court and the left sideline.

Backslide or bs: This ball is put in the vicinity of the b1 or the red and I have not shown it separately.

Here, the middle hitter runs behind the setter and takes off from one foot instead of planting. The backslide is almost never used in the men's game but is a staple of the women's.

Dump or d: Someone, usually the setter, going over on two.

There are also combination plays in which two hitters converge on one area of the court and the setter picks which one to set depending on the blockers. We will discuss these in Rotation 2.

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

And that's about all the knowledge that is required to begin charting. We can now set about filling in the courts with numbers, circles, and arrows, eventually to be augmented with paragraphs to be used in evidence against ourselves.

Rotation 2: Find the hitters

The good chart-taker tries to notice as much ball and player movement as possible. Where is the best place to watch a match? For note-taking, it is an endzone seat, high enough to see both teams. The Pyramid at Long Beach State is particularly good in allowing a panoramic view of the action. If an endzone seat is not available, a high bleacher near the endline is good for an oblique look angle. This tutorial is geared toward charting all of the attacks of one team.

Let us suppose that an endzone seat is available behind the team being charted. The first step is to identify the three front row hitters. Veteran chart takers can tell from the serve-receive lineup who is in the front row and who is the setter. If the team being scouted is serving first, the problem is trivial, look at the blockers and write down their jersey numbers in the upper halves of the three squares below the top chart and note the server's number in the circle. Do this before the ball is contacted for serve because the blockers will usually switch positions, record the actual blocking alignment in the lower halves. Recall that the bottom chart is used only when a team is receiving serve en route to its first attack. The top chart, reserved for transition, is the appropriate location for noting plays on serve and on transition off of the serve-receive.

If the team being charted receives serve first, one can usually forgo the first rotation and wait until the team serves.

Most men's teams use two players, opposite each other in the rotation, to receive 95% of the serves. These are the swing hitters, one will always be in the front row. There will be one middle hitter/blocker in the front row at all times as well. Also, since most teams run a 5-1 offense (five hitters, one setter) there will only be two front row hitters in three rotations. Knowing the location of the opposite is, therefore, very important since he will likely get a lot of sets as a backrow attacker. Women's teams typically use a three-person receive alignment in which different sets of three pass in different rotations. The advent of the jumpserve in the men's game has also forced most teams to move a third man up to help.

Example:

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically. While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

We are at the UCLA Pepperdine match on Valentine's Day, 1996. This is the Kilgour Cup in honor of legend Kirk Kilgour. We have decided to take a chart on UCLA.

Scenario:

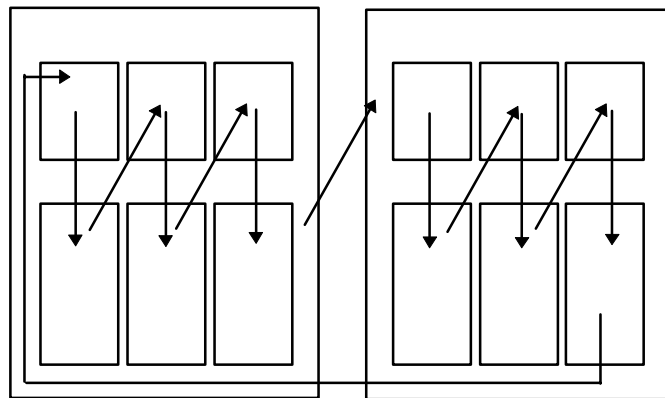
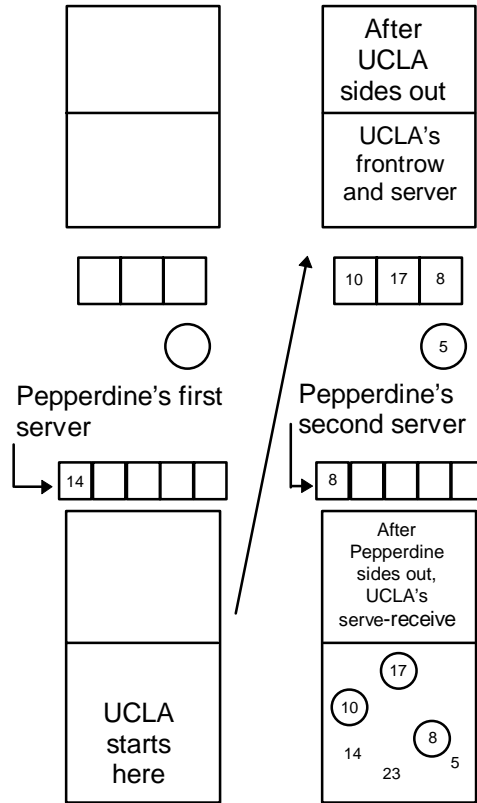
Pepperdine serves first in game one. After siding out, Bruin setter #5 Stein Metzger goes back to serve, with #10 Paul Nihipali (the Opposite) at left front, #17 Tom Stillwell in middle front, and swing hitter Brian Wells #8 in right front. Pepperdine sides out and UCLA goes back to receive serve. Here is one approach to taking this information down. Chart elements not used have been trimmed for clarity.

Implementation:

The image shows two of the three columns of a chart page. Beginning at the lower left, we note that #14 of Pepperdine, Kevin Barnett is the first server and UCLA is receiving. We decide to forego guessing who is in the front and backrow for UCLA for now. UCLA sides out and we move northeast to the transition chart. We note the UCLA server (#5) and the left-to-right alignment of the front row players (#10, #17, and #8.)

Pepperdine sides out and we move due south to the next UCLA sideout rotation. We find Nihipali, Stillwell, and Wells and put their numbers on the chart, we circle these to indicate they are front row. If Brian Wells is right front, that must mean the other swing hitter (#14 Fred Robins) is left back. Sure enough, he is to the left of the other middle #23, James Turner. It follows, therefore, that Metzger must be right back and he is indeed starting from the right shoulder of Wells. The back row player numbers are not circled. We note furthermore that Peter Kodacsy, #8 for the Waves is serving in this rotation in this game.

This zig-zag is the fundamental pattern. At the end of three rotations, we flip the page and continue. And when all six are finished, we flip back to the first page. Very straightforward.



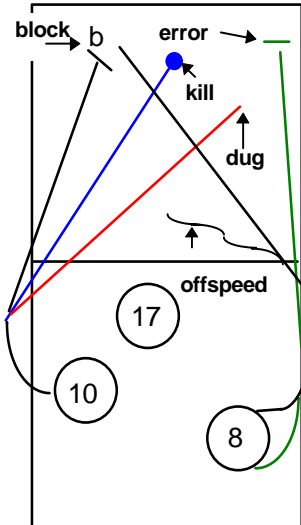
Rotation 3: Serve-attack

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

There is a frenzy of activity on both sides when the ball has been contacted for serve. The serving team's blockers will usually switch positions and the backrow players will accommodate the server moving to his defensive spot. The situation is crazier for the receiving team. The setter breaks to his position along the net, one passer usually moves to the ball, and the balance get to their hitting positions. The ball is set and someone takes a swing at it. A kill, error, save, or block are the possible outcomes. The chart-taker's goal is to note the type of set, who hit the ball, where, and the result. For a first pass, we'll consider only diagramming the play as it occurs.

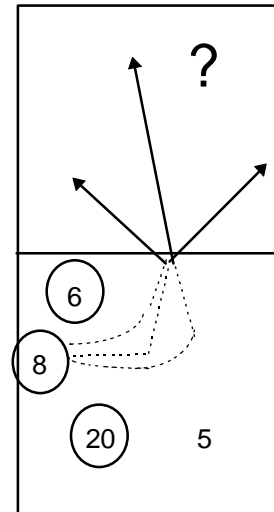
For the outside and backrow attacks, we are interested mostly in the direction of the hit and the result. We look to see where along the net the hitter takes the ball and where it goes. If it goes into the opponent's court, this is a relatively simple matter. If the ball goes off the block, we try to assess where the ball would have gone. One advantage to the endzone charting position is that we can see the hitter's hand and extrapolate whether he was hitting to the line, seam, or crosscourt. We then draw a line from the hitter's number on the court, indicate his approach, and the direction of the hit. My convention is to use a filled circle to represent a kill (ball put away, tooled off the block, blockers in the net,) an unterminated line for a dug ball, a minus sign (-) for a hitting error of any kind (ball hit out, into the net, outside the antenna, and hitter into the net,) and a b for a block. Wavy lines indicate off-speed shots and tips. The figure shows some examples. Different colors represent different games.



The middle attacker is a little more tricky. In two of his three front row rotations, the middle starts away from the center of the court. As soon as the ball is contacted by the server, he begins to move toward his hitting position. Coaches are particularly interested in how the hitter gets to his spot and in which direction he hits the quick set. Since the middle attack is greased lightning, the blockers need to know whether a middle prefers to hit in the direction of his approach or whether he cuts back against it. They may then set up accordingly. If the passing is good and the middle can hit either way, then, the defense is in for a long night.

This fragment is from the Stanford/Long Beach match of March 1996. #20 is frontrow passer Matt Fuerbringer, #5 is his batterymate Aaron Garcia, #8 is middle hitter Keenan Whitehurst, and #6 is the setter, Stewart Chong.

The chart taker, therefore, must keep the middle hitter in focus and note with dotted lines, or in his mind, which way the middle comes in. If the middle gets set, he pays particular attention to the hitter's hand if possible and to where the ball goes. In women's volleyball, the backslide is a commonly used option. A beginner may simply treat the middle as any other hitter and move towards noting approaches after accumulating some experience.



May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

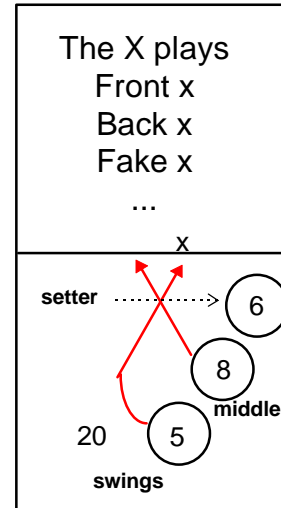
While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

Combinations:

The multiple-option volleyball offense manifests itself most powerfully in the combination play. Multiple hitters go flying in, the setter looks at the block, and decides whom to set. Although usually found mostly in the men's game, women's teams are beginning to use it more frequently.

The front row middle x-play is the most popular variant. The name "x" arises from the crossing paths of the middle hitter and one of the front row outsides. The setter decides whether the blockers are committing on the first player in. If they are, he waits and sets the second option. If the blockers read the first hitter, the setter sets him instead. The diagram shows an "x1" play. Typically, one diagrams the approach, hit, and result of the player who got set and marks a small "x" to indicate that it was a combination. This is easier than trying to write down both approaches and guess later who actually got the ball. If the combination hitter swings out to the left or right side antennae, the set is called an x4 or an x5.

This sketch shows a different rotation from the Stanford/Long Beach match. Stanford ran xs all night long in this rotation, in front and behind the setter, with Chong setting both options and confusing the block.



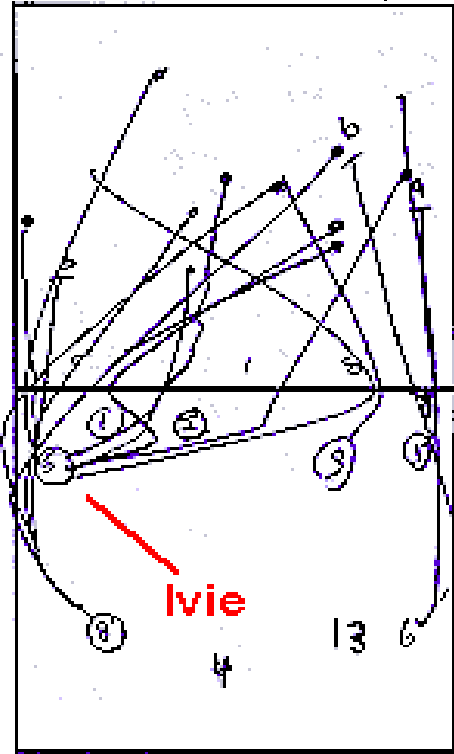
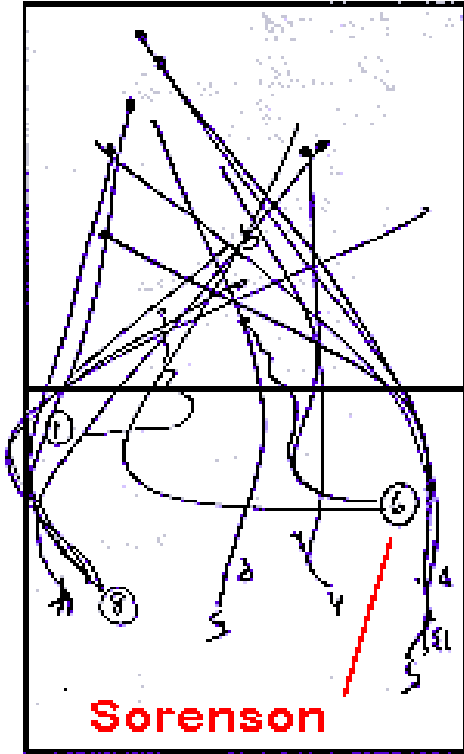
The University of Hawaii men's team has a long tradition of running the "double quick (dq)" in which the middle and rightside hitters go in quickly to their normal hitting positions. Imagine a combination of the 31 and the red sets. (This is also called a 35 since one player is going to the 3 position and the other to the 5.)

The x play in transition is especially fun to watch. Few teams have the ball-control to execute such a timing pattern. The Stanford women of 1996 did. They often used a great, high dig to let middle-hitters Eileen Murfee or Barbara Ifejika take out the blockers, freeing up freshman phenom Kerri Walsh who came in behind her uncontested. Examples of this will be shown later. With the advent of the 6'8" big-banger in men's volleyball, the backrow combination is gaining popularity. Typically the front row middle will go in to take out the blockers and a backrow player gets set, usually a Pipe. I note this as an "x-Pipe," others, such as Coach Andy Read of Long Beach State, call this a "bic," short for back-row quick.

Consider another example from an actual match: USA versus Italy at the Great Western Forum in 1995. Look at the hitting approaches of Tom Sorenson (#6) and Bryan Ivie (#5) in two separate rotations. Scott Fortune (#8) is the leftside swinghitter, Bob Ctvrtlik (#4) is his battery-mate. Lloy Ball (#1) and Jeff Nygaard (#13) round out the US lineup. The whole chart may be found on my volleyball page. This is a combined sideout/transition scheme I experimented with and quickly abandoned. One key feature of the match is the small numbers of minus signs and blocks. Our boys beat the World Champions by playing error-free ball and executing well on defense.

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

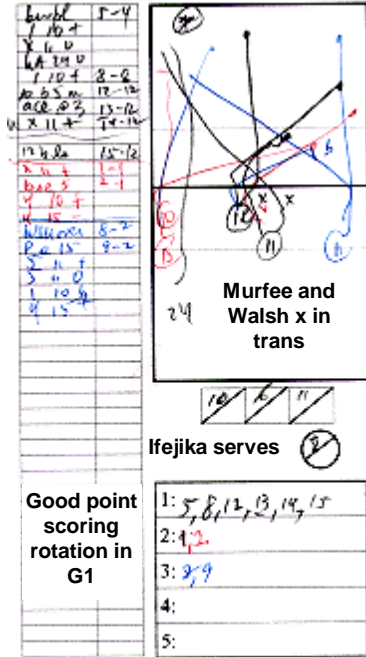


May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan



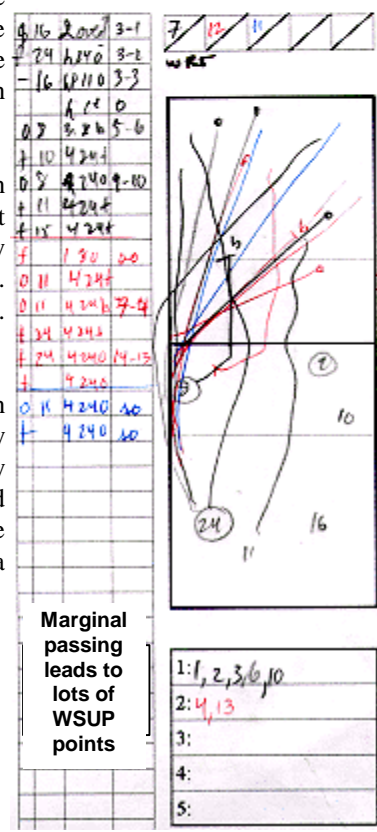
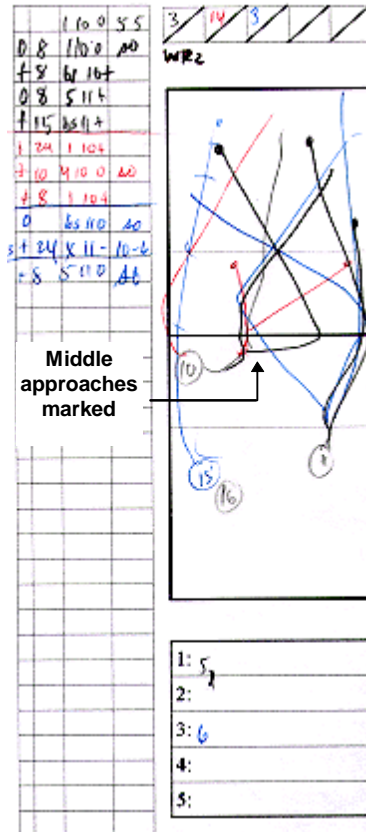
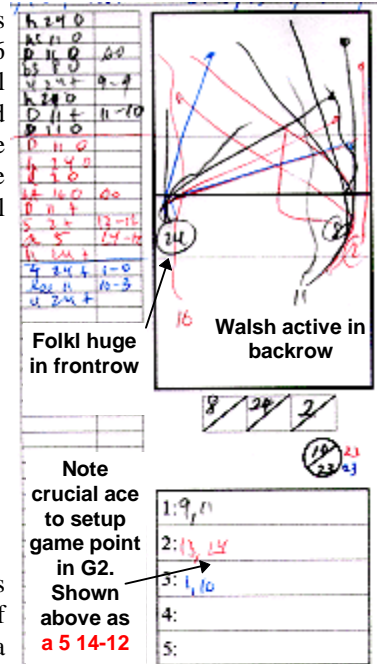
This, more detailed example comes from a chart I took at the 1996 NCAA Women's Pacific Regional Final match between Stanford and Washington State. Focus on the courts and the scoring boxes. The notations in the tabular columns will be discussed in Rotations 5 and 6.

- Cardinal Roster:
- 2 - Lisa Sharpley (S)
 - 8 - Barbara Ifejika (MB)
 - 10 - Eileen Murfee (MB)
 - 11 - Kerri Walsh (OPP)
 - 15 - Debbie Lambert (OH)
 - 16 - Jaimi Gregory (OH)
 - 24 - Kristin Folkl (OH)

This is the future of women's volleyball: A combination of physically gifted athletes and a diversified offense that keeps the ball and players moving all over the court. Long Beach State and Notre Dame also show signs of this when their teams are healthy.

Note the number of transition opportunities indicating great defensive play and the wide variety of shots used by all of the hitters. The few wavy lines indicate tips. Most of the balls were hard driven.

Washington State also played an exceptional match. Although they lost in three, each game was closely contested. Sarah Silvernail showed why she was Pac-10 Player of the Year as Stanford slowed her down a little but never stopped her.



May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

Rotation 4: Intragame Transitions

After a team has served or completed its first attack, it is time to move up to the top chart for further plays. In my chart, I have made the transition area smaller so I could have extra room for the more numerous S/R/A plays. Backrow defense in the men's game is improving about as fast as women's offenses are diversifying. Slowly, sometimes painfully, but, inexorably forward. Longer rallies are a nice feature of the women's game and these require more attention to be paid during the transition plays.

The charting ideas in S/R/A still apply in transition, no more schematics are needed. Let's consider another real-life example. The USA Men are playing Japan in a two-out-of-three exhibition at the Great Western Forum. #6 Tom Sorenson, #13 Jeff Nygaard, and #4 Bob Ctvrtlik are available hitters in this transition fragment. Compare and contrast this image with its S/R/A partner below, black signifies game one, red game two. In S/R/A, Ivie is bombing D balls. Sorenson starts right front and hits in two different areas, Ctvrtlik likewise. Nygaard, the opposite, is getting mostly leftside sets and favoring line/seam.

Note the fewer sets in transition. This is often, but not always, the case in men's sixes. The main point in transition charting is that due to blocking alignments, players can be in very different parts of the court. Note that Sorenson's one set came in the middle and that Ctvrtlik goes to both sidelines. We simply note wherever the hitters hit from, duplicating numbers as necessary. Now, compare and contrast this bit with the full six rotation chart available from my Web page. Less razzle-dazzle in transition, setter Lloy Ball gets the ball to his big guns and lets them swing for it. Determining who these big guns are is an exercise for the reader. Compare and contrast with the previous chart fragments from the Stanford/Washington State women's match.

If the rally continues, one can either try to recall all the plays after the ball is put down or jot as play proceeds. I do both, depending on my fatigue level. Experiment with what works best for you.

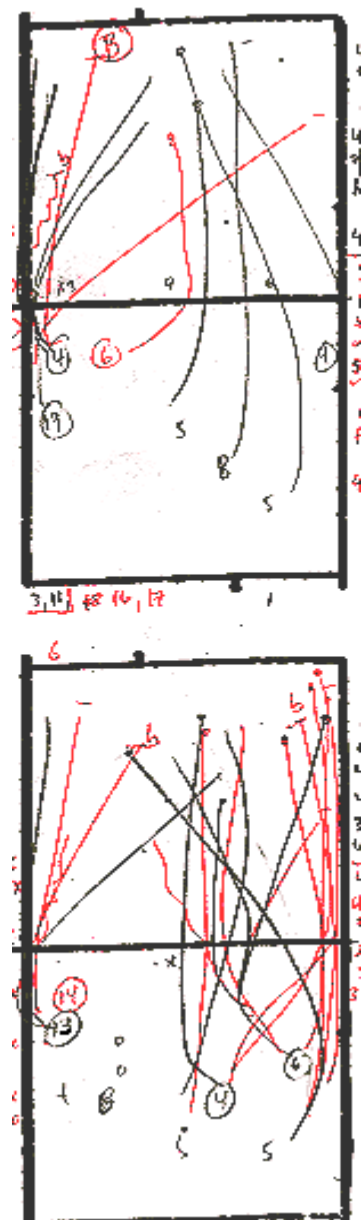
So, who is the red #14 on the bottom? That is young Mike Lambert who came in as a substitute for Nygaard in game two. And this is how one handles substitutions, just put the number of the player adjacent to the fellow he replaces. The tricky part is to do this quickly in each rotation.

Intergame Transitions:

We suppose now that the first game has concluded. The teams change sides and often come out in different rotations, occasionally with different personnel. We identify quickly who, if any, the subs are and then identify in which rotation the team we are charting chooses to begin. This is straightforward after a little practice. If there is a pause between games, we look over the "take." Note any particularly good or bad rotations, chances are that one side will attempt to adjust.

One of my usual watchpoints is set distribution in transition. I look to see if the setter gets tentative and bails out to his biggest gun or whether he keeps all of his hitters involved. In some matches, other events take precedence. In the men's game, it is often passing collapses which destroy any offensive rhythm a team hopes to establish. This is covered in detail in the next Rotation.

Chart the first game in pencil so that errors can quickly be erased. Mechanical pencils are especially useful. If at all possible, use a different color to chart each game so that it is possible to see tactical changes at a glance. A "pre-med" multicolor pen comes in handy. This is a large-barreled device with four (or more)



May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

colors available at the push of a button. Put an arrow or other marking near the court where the game begins.

It is important to stay focussed and not assume that the teams come out in the same rotations. Find the opposing server in each rotation and note his number. This is important information and it is also a good check of internal consistency.

The side change forces us to do a mental inversion of player positions. The right side hitter is now across the net on our left side, etc. This part takes a little getting used to and requires some practice. Since the clipboard is still oriented the same way, we must accurately describe the ball's trajectory on the chart. This becomes easier with time.

Rotation 5: Shorthand notation of plays

Those familiar with computers will immediately realize that the chart is a parallel, all-at-once, representation of a match. Different colors can distinguish among games, there is no way to tell the sequence of plays within a game. We need a complementary "serial" data stream for meaningful analysis. The space along the left sideline is ideal. For a long time, I wrote down this margin. More recently, I've added a tabular form to make writing (and subsequent reading) easier.

Consider the tabular columns in transition (top) and S/R/A (bottom.) Focus on the third column, "Play," in S/R/A. Here, we note the set (refer back to the figure on page four,) the hitter, and the result.

- + = kill. Ball goes down, off the block, blockers in net
- 0 = dug ball. Ball is played up by defensive team
- - = hitter's error. Ball in net, out of bounds, outside antenna, hitter contacts net
- b = ball blocked successfully

h 8 0		
1 15 b	4-3	
D 10 +	8-3	
14b6 ls	9-6	
31 17 -	so	

Point allowed/scored...

Transition play

The small "h" in front of a set signifies a "high ball," signifying a very imperfect, hard-to-hit set. An h5, for example, is a bailout set to the rightside. These result from bad passes in serve-receive or, in transition, when the setter doesn't handle the second contact. We generally cheer a player for putting away a high ball, we don't hold it against him if he doesn't.

+	14	1 15+	
0	8	P10b	0-1
+	8	b124-	0-2
-	14	h 8 0	so
+	8	x4 8+	
a	8		8-5

S/R/A Play and result

Pass rank and passer

The situation is the same in transition. I have developed a notation of my own to keep track of mistakes by the opponent. The reason behind this will be explained in Rotation 6 where we discuss keeping running scores and notes. The space for the set can also be used for other information. For example, I'll write "bus pl" for a busted play by the opposing team, "lse" for a leftside error by the opposing hitter, "2brsh" to indicate that the opponent's right side hitter got stuffed by two blockers, "j" for joust, etc. If possible, I try to get a jersey number, i.e. 13 e m means opponent's #13 made a hitting error in the middle. I don't always succeed at this, however. Consider the penultimate play listed in the transition columns: " 14 b 6 ls 9-6" This is my way of noting that #14 of the team I am charting, blocked #6 on #6's leftside attack, scored a point for 9-6.

Similarly, going down the S/R/A plays, we have a quickset to #15 for a sideout, a block of #10's Pipe for a loss of a point, a hitting error on a back 1 by #24 for another loss of point, a high ball on the leftside to #8, dug up by the other team but still leading to a sideout. We then come around later to a leftside combination play to #8 for a sideout and after that, an ace of #8 making the score 8-5.

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

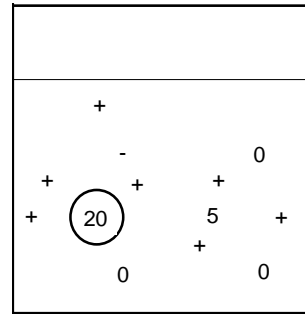
While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

The left two columns in S/R/A have no counterpart in transition. Coaches are always interested in how well the passers are receiving serve. These are usually ranked on some kind of a four point scale. Mine is

- + = perfect pass, setter has all three options
- 0 = setter can set outsides but not the middle
- - = high ball in desperation is the only option
- a = ace
- op = overpass

An alternate possibility is to rate a perfect pass as a 3 and an ace as a 0. Many teams use this approach to compute a numerical passing average. This scheme does not presently account for what the other team is doing on serve. Jumpserve, hard floaters, serving location, etc. Some chart-takers note this as well.

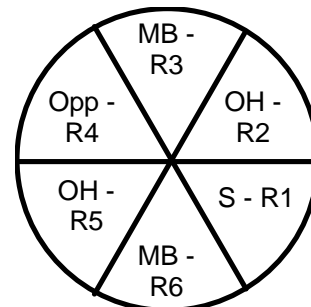
I put the pass ranking in the leftmost column and the passer in the next column. If there is an ace, I also try to put a small asterisk on the chart where the ace went down. One reason to use a +/0/- passing ranking is that a symbol can be placed **on the chart** where the receiver passes the ball. Many chart-takers do this to have a visual indication of where serves are most effective. Passing rankings are not relevant to transition so the columns are excluded. There are a few aggressive setters out there who will set the middle even on a bad pass. Metzger of UCLA and Chong of Stanford come to mind. I bite the bullet and give the passer a good ranking if his setter can set the middle-by-miracle play. This can go both ways, pick the convention that you like and stick with it.



Rotation 6: Tabulating the score and taking notes

Some rotations are better than others. The object of the game is to score points while minimizing points allowed. Which rotations are getting the job done? How are the points being scored, how are they being lost? We can note these on the chart as well. The rightmost column is for noting a pertinent result. If a point is scored or given up in transition, the score can be noted in the space provided. In S/R/A, points can only be allowed, not scored. If a play results in a kill, it is by definition a sideout. The space can be left blank or used to note number of blockers up, etc. If the result is an error or block, a point has been given up and the running score can be noted. If the attack is played up (ie. a "0" in this notation,) the play could result in either a point being scored or a sideout and may be noted accordingly.

Match rotations are usually numbered from R1 to R6 with R1 defined as setter in the right-back position. A rotation "pie" is often drawn up and numbered as shown. This is the case where the setter "pushes" a middle blocker and "pulls" an outside hitter. The reverse is also possible.



May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically. While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan
 The following comments apply to games one through four in conventional sideout scoring where points can only be scored by a team in transition. Similarly, points may only be lost in S/R/A. Let us consider the remaining column in the figure from Rotation 5, the transition portion first.

We note transition plays as usual. If a play results in a point, we put the score in the second column. If the team receiving serve loses a rally while in transition, we can note this as well.

Back now to serial versus parallel. We wish to know, at a glance, how many points each rotation wins or surrenders. When the team being scouted wins a point, it will be in transition, so, below the upper chart, there are rows marked 1: to 5:. We note here which point was won and in which game. When the team gives up a point similarly note it in the space below the S/R/A chart. *Remember that points may be lost in transition so do not neglect to drop down to the S/R/A chart to so note.* Is it redundant to keep a running score on the left column as well as in the box? Perhaps, but, it is much easier to see how many points were scored and allowed in the bottom box. The table correlates which play scored which point and is complementary.

With the advent of tough jumpserve, the ace is becoming much more common. To reflect this, we underline any point scored in such a way. Not only is this a quick histogram of good and bad rotations, I occasionally see that teams give up the same points in certain rotations. This may be a window into concentration lapses if properly analyzed. Although beyond my scope, I find it interesting nevertheless.

Examples of noting plays and scores follow. The first page is Stanford's R2 (transition) versus Washington State in the 1996 NCAA Women's Pacific Regional Final. The second is Stanford's R6 serve-receive against USC in the semifinal match the night prior.

h 8 0		
1 15 b	4-3	
D 10 +	8-3	
14b6 ls	9-6	
31 17 -	so	

1: 4,8,9
2:
3:
4:
5:

+	14	1 15+	
0	8	P10b	0-1
+	8	b124-	0-2
-	14	h 8 0	so
+	8	x4 8+	
a	8		8-5

1: 1,2,5
2:
3:
4:
5:

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

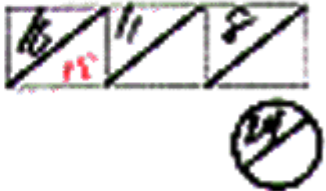
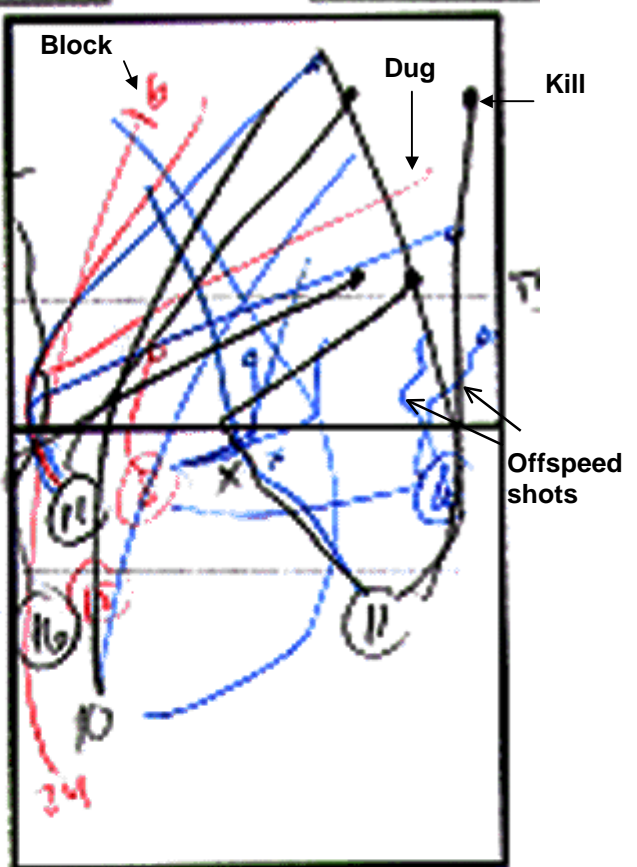
While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

Stanford R2 (trans) vs. Washington State

NCAA 1996

- hi to Walsh, point (also noted below) →
- Walsh rightside to tie at sixes →
- hi backrow Murfee, dug →
- x play Walsh, point →
- Change color for G2 →
- Folkl blocked backrow. sideout →
- Op 8 + 15-13
- Ifejika kills overpass for game →
- Triple block of WSU #11 for 3-0 →
- WSU shanks, 5-0 →
- Gregory over on two, d 16 +, for 6-0 →
- 4 11 + 7-0. Walsh (who else?) scores again →

4-4
4-6
5-11
4-16
10-0
11-0
13-6
4-0
3-6
3-11
3-0
4-0
5-0
6-10
6-0
7-0
8-0
9-0
10-0
11-0
12-0
13-0
14-0
15-0
16-0
17-0
18-0
19-0
20-0



Women's Pacific Regional Final

1: 4, 6, 0
2: 5, 15
3: 3, 4, 5, 6, 7
4:
5:

Points scored noted here as well as next to plays in the left-hand column

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

Stanford R6 (S/R/A) vs. USC

NCAA 1996 Women's Pacific Regional Final

Missed pass, hi to Folkl, dug but Stanford sides out anyway

Folkl overpasses, Sharpley wins joust, sideout (op 24 j 2 +)

So-so pass by Walsh, backrow set to her, WSU digs and converts to go up 2-0

Good pass Gregory, not great backslide (h bs) to lfejika, kill and sideout

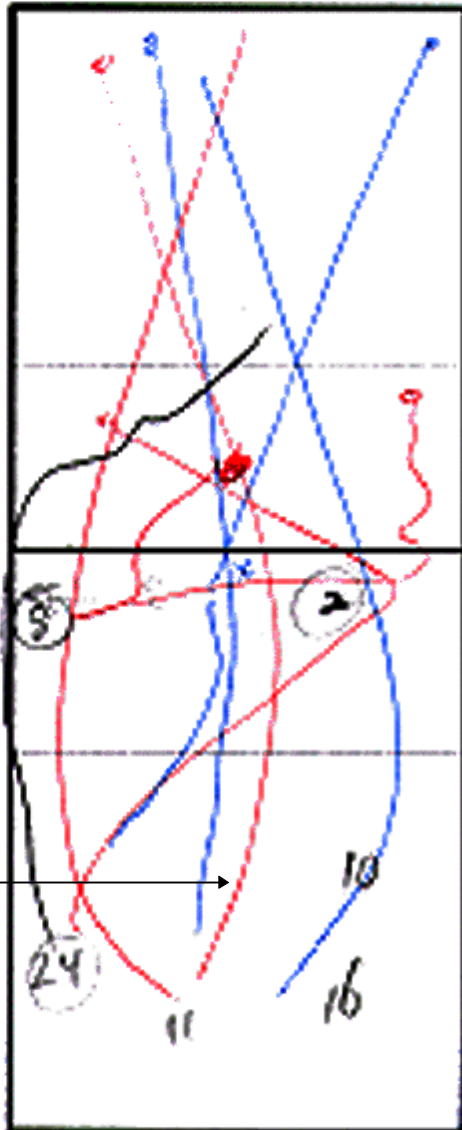
Good pass Gregory, Folkl on combination, sideout

Pair of so-so passes Gregory, Sharpley sets Walsh backrow, pair of eventual sideouts (C 11 0, P 11 +)

		h 240	00
→		op 24 j 2 +	
→		0 11 B 110	1-2
→		1-16 S 98	0-3
		0 16 P 11+	
→		1-16 h 5 81	
		1 16 65 244	
→		1-16 x 247	
→		0 16 c 110	20
→		0 16 P 11+	



USC's servers by game



Note the extensive use of the backrow attack. Very manly-man.

1: 2,3

Wrote G2 score (red) in G1 space. That's a bad dig by me!

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

Match Notes:

Shorthand is no substitute for narrative. The space at the very top of the chart sheet has room for notes. Use this to note who starts in the various games, positions, and, perhaps some comments on the quality of the warmup tape. We may also use this to keep a track of the running score, the advantage being not having to look through two sheets up and down in the columns for score data.

Start at 0-0 and when a point is scored, make a note of the score as shown. This will involve page flipping, but, it is possible to track these data without losing place. This is another good reason to keep track of the opposing server. It becomes very easy to spot rotation slipups.

Small handwriting is an advantage since small notes can often help to recall important events. Develop a system to track real, not momentum breaking, substitutions. If there is a play, call, or series that is particularly memorable or relevant, write it down. If you think a coach has completely lost his marbles, write it down. Timeouts are often crucial. If a team goes from 0-3 to 5-3 and the opponent calls timeout, write it down. And don't forget to write the final scores!

The example below also comes from one semifinal of 1996 NCAA Women's Pacific Regional. This is page one out of two for the match between Stanford and USC. Note game scores, rosters, running scores, and assorted comments.

12/12/96		Stanford vs USC 1/2	
1:	15-3	1. USC: 4, 9, 11, 14, 15, 16 Stan: 24, 6, 11, 14, 22 1-0, 3-0, 5-0, 7-1, 4-1, 5-1, 8-1, c. delay on a-b; (leadup!!) 5-2, 5-3, 6-3, 7-3 Tusc; 8-3, 9-3, 10-3 11 setting 24; 11-3 Tusc; 12-3, 16 set 13-3, 14-3, 15-3.	
2:	15-7	2. 0-1, 0-2, 1-2, 2-2, 3-2, 4-2, 4-3, 4-4, USC penalty 11 is ready; 5-4, 6-4, Tusc, 7-4, 8-4, 8-5, 8-6, 8-7 TS (3, 4, 5 in normal) 9-7, 10-7 First USC for 16, 11-7, 12-7 Tusc; 13-7, 14-7.	
3:	15-7	3. Time fantastic, 1-0, lots of s.o.s. about Jan, 1-1, 1-2, 1-3, 2-3, 3-3, 4-3, 5-3, 6-3, Tusc; 7-3, 8-3, 9-3, 10-3, 11-3 Tusc; 12-3, 12-4, 12-5, 12-6, 13-6, 12-7.	
4:			
5:			

The rally scoring fifth game presents obstacles to this approach. Game five is so quick, it is hard to keep an accurate track of point scoring while diagramming. I have resigned myself to taking score information wherever there is empty space and making cryptic comments about important plays.

With that, we conclude our formal tour through the hitting chart. In the Hospitality Suite, I present some opinions on what to do with the information that can be collected.

Postgame: The Hospitality Suite

After taking a chart, it is always a good idea to go over it and to see how the match developed. Look for trends in the hitting areas, look for scoring patterns, and look at passing quality. Identify the pie that the opponent used in each game. Were there any substitutions? Any alignment changes? How effective were they? Who played well? Who didn't? It is also possible to go down the margins and determine hitting averages for individuals and the team as a whole. A chart can contain a wealth of information in a very small space. Taking a chart forces concentration and focus, it can enhance your appreciation of the match, and, most importantly, *it slows the match down*. Once you begin to see patterns and rhythms, the game stops being merely a collection of individual plays.

If you have read this far, I hope you will consider trying out some of the ideas here in actual match situations. And I strongly urge that you write up your analyses for the rec.sport.volleyball newsgroup on the Usenet. The sport lacks serious media coverage and suffers from a general lack of respect. Fans must get involved beyond merely watching, it will be up to the fans to generate and sustain serious discussion of the sport.

Volleyball coverage in magazines is dated and stale. The writing focusses on personalities and politics. We cannot expect anything resembling match analysis from the mainstream volleyball publications in the near

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

future. The powers that be are loath to transfer even one more page per issue away from profiles and onto commentary. It therefore falls upon the fan to pick up the slack. The fan's comments will not have the authority of those from a seasoned coach or veteran player. They will not have the depth that these people can provide. But, the fan can write about matches from his personal perspective, from the heart as well as from the head and, over time, these can help keep others far-flung up-to-date and involved.

The **worst** thing to do with a chart is to share it, unsolicited, with a coach. Especially after a match. Especially after a loss. Share it with friends, family, and cherished pets, but, leave the coaches out unless you are specifically asked otherwise. And **never** show it to players without the permission of the coach. Statistics are only relevant when used in specific situations with due respect for error margins. **If you are charting a collegiate match in the USA, be aware that coaches may not accept such reports on teams not their own from those who are not on their staff.** This is an NCAA rule. It is very easy to try to distill a match to a hitting average here or a passing ranking there. Players should not get hung up with this, they should focus on the big picture of improving their game and that of their team. Statistics are only a very small part of that picture.

I have, on occasion, shown coaches my work as a token of thanks for the pleasure of watching their teams and had it blow-up on me later. Some interpreted the gesture as trying to cozy up to their programs. Chances are that a person with a clipboard will be noticed. If you are asked, offer. Take suggestions and learn, it can be vastly enjoyable. If not, realize that most teams have people on staff to handle these issues and that it can be awkward to decline well-meant offers of scouting help when the caliber of the analyst is unknown.

Statistics:

Collecting and analyzing statistical data is by no means a trivial task. Statistics, broadly defined, deals with making a large number of measurements under controlled conditions with a view towards understanding distributions of results and likelihoods of outcomes. Statistics cannot, in general, be used to predict outcomes of one or a small sequence of plays. It is possible to compute averages for just about anything associated with volleyball. A common number is the hitting efficiency, defined as $(\text{Kills} - \text{Errors}) / \text{Total attempts}$. A kill is assigned a value of +1, an error a -1, and a dug ball a 0. The hitting efficiency is an average: Add the results, divide by the number of samples. Passing rankings can be similarly analyzed.

Most of us think of Gaussian statistics when we think of statistics at all. Grading on a curve refers to just this. In order for the methods and concepts to be useful, there **must be a large number of samples**. That is, before comparisons can be made and conclusions drawn, the base of data must be substantial. A hitting efficiency of 75% may look great compared to one of 35%. But, how many swings did the hitter have? This often shows up when a setter has three dumps go down out of four tries whereas the outside hitter had forty swings against big blocks.

Statistics are also compiled by human beings. There is some amount of subjectivity and room for error in tabulating kills, errors, digs, blocks, and especially pass quality and block assists. The fewer the number of samples, the larger the effect of any error. In addition to finding a mean or average value of a distribution, another equally important quantity is the spread in the distribution. One measure of this is the "standard deviation" which quantifies how fat or skinny "the curve" is. Two players may have the same passing average although one might fluctuate wildly from shank to perfect while the other is a steady source of balls just not quite good enough to set the middle on. Which is better?

Finally, it is not meaningful to compute results to higher accuracy than the raw numbers that go into the equation. This is the concept of "significant figures" that is drilled into every college student that takes a semi-rigorous course in physics or chemistry. Very crudely speaking, if the input values have one or two digits in them, any number derived from them should only be taken to two or three digits, maximum. It doesn't matter if the laptop or calculator gives thirty decimal places. In practice only the first couple will matter. This is especially important when people compare a "438" hitter against a "406" hitter, the assumption being that one is wildly better than the other. Consider the following box score from the 1996 NCAA Women's Championship match and compare Walsh and Folkl's hitting percentages.

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

Team: Stanford University

No	Player (Last, First)	GP	K	E	TA	Pct	A	SA	SE	RE
2	Sharpley, Lisa	3	2	1	7	.143	37	-	1	-
8	Ifejika, Barbara	3	6	1	13	.385	1	1	-	1
10	Murfee, Eileen	3	4	3	11	.091	3	-	-	1
11	Walsh, Kerri	3	17	3	32	.438	6	2	2	-
15	Lambert, Debbie	3	10	2	23	.348	1	-	-	-
16	Gregory, Jaimi	3	-	-	2	.000	-	-	-	-
23	Neal, Sarah	2	-	-	-	.000	-	-	1	-
24	Folkl, Kristin	3	16	3	32	.406	1	0	2	-

First, there are only two significant digits in the numbers so we should compute three places and round off to two. Folkl had one fewer kill than Walsh, the same number of errors, and the same number of swings. This is either the difference between a "438" and a "406" hitter or merely the difference between one who hit for 44% and the other for 41%.

Some coaches claim that the numbers can be a tool for motivating players or at least keeping them in line and happy with their (lack of) playing time. This is perilous. Second stringers seldom see court time, especially in men's volleyball. The starter is going to have an intrinsic advantage of working with a particular setter, getting a huge number of reps. The scrub is not. Using straight numbers in this fashion is dishonest. The wise coach must not give undue importance to the stats.

Why this long digression? I originally wrote this tutorial for fans in the hopes that more would chart for the sheer pleasure of it. That experiment has been a dismal failure. Virtually all of the people who responded to me about Version One were coaches or interested in becoming coaches. Such overwhelming numbers cannot be neglected. For those of you interested in this subject, Stephanie Schleuder is writing a book on volleyball statistics, to be published by the American Volleyball Coaches Association (AVCA) in early 1997. Be sure to check the AVCA's website (<http://www.volleyball.org/avca>) for more information. Schleuder was until recently the coach at the University of Minnesota.

Sermonizing:

The amount of material in a chart may seem large at a first glance. This is true and that is why charting is popular in the coaching community. It is, however, substantially easier than it looks. The goal of this tutorial was to show that a few simple steps, when repeated in a logical and consistent fashion, can enable even the beginning fan to create an accurate representation of a game. All that is required is some familiarity with the sets and common plays and an ability to dispassionately write down results. I offer my own story as proof.

I began following volleyball in earnest while I was a graduate student at Stanford in the mid-to-late 1980s. The Cardinal women were (and are) a perennial power. While walking home from the lab one night, I stopped by a tournament being held at Maples Pavilion. I watched Wendi Rush set Teresa Smith and Nancy Reno who demolished both the ball and their opponents. I got hooked and got my labmates to join me for future events.

The Stanford men, that year, were without Scott Fortune who was training with the National Team for the 1988 Olympics. I and a couple of my friends were some of the few who watched the men's program. At this time, my knowledge of the game was still bump-set-spike. Later that year, there was an ad in the student paper for volunteer assistants to the volleyball teams. The women were seeking a manager, the men a statistician. There were a dozen clippings on my desk with the women's team job circled and assorted "Ha has" scribbled nearby. There was no way in hell I was going to try for that job, but, the stat thing looked very interesting.

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

I called Ruben Nieves, then assistant to both programs and my teacher in Volleyball 101, and offered my services in case no one else was interested. And in the volleyball hotbed that is Silicon Valley, by some miracle, no one wanted that job. I won the position by default.

I recall vividly my first meeting with Coach Fred Sturm who asked me about my qualifications. I had none. He showed me some charts he had taken and asked if I knew what was involved. I had no clue. He pointed to the shorthand notation of plays and asked if I knew what they meant. No idea, sorry. I literally did not know shoots from shinola. And it was with a sketch, roughly along the lines of the figure on page four, that he began to teach me how to take a hitting chart.

Once I had the sets down, Fred showed me what was involved in determining hitters, diagramming plays, and making notations. I practiced at women's matches and was ready when men's season '89 rolled around. I got to watch Scott Fortune and Dan Hanan lead the Cardinal Men to the NCAA Finals against UCLA, at UCLA, with UCLA's home fans, and UCLA's home referees. Although Stanford lost in 4 games, it was a marvelous season. I was able to do the same thing the next year as well, before graduating. Fred is an excellent teacher as well as a coach and I was able to see a lot of connections between his approach to his sport and mine to my profession.

Charting is not necessarily scouting:

The charting scheme described here does have its weaknesses. Although passes are ranked, the serves leading to them are not. The chart shows one team nearly completely, the other only in bits and pieces, if that. There are any number of different methods available, most quite probably better than the one described here. While this tutorial gives an overview of what can be done, it should be considered only as a point of departure.

One other reason not to randomly offer charts to coaches is that a chart does not necessarily make for a scouting report. Coaches scout opponents with a firm grasp of their own team's capabilities. They look for specific patterns and are concerned greatly with how to play off strengths and weaknesses. Most coaching staffs have therefore developed their own schemes for getting these data. This tutorial is good preparation for learning how to watch a match as something more than a series of disjointed plays. It is not necessarily the scheme that any specific team uses or can use the information from.

To computerize or not to computerize:

I am occasionally asked if computer-based charting and stat-taking methods are available. There are. So, why take a paper chart at all? I personally enjoy the feel of pen on paper, I like scribbling rather than typing for many things, and I appreciate doing this on the cheap. A clipboard, pen, and paper costs about five dollars. A laptop configured for charting will cost at least two thousand dollars. I find that I can draw much more quickly with pen and paper than with a trackball, thumb mouse, or other 1996 pointing technology. I find it easier to whip out a piece of paper over a post-match dinner with other fans than to set up a laptop. It is also easy to archive the results. Folders are cheap. Teams looking for detailed analysis and sophisticated archiving may do better with a computerized system. I still believe firmly that such analyses cannot be blindly trusted to a software package and that the person analyzing the results must have a good background in statistical methods in addition to a jaundiced eye.

Charting children's matches:

I have heard from high school and club coaches who are interested in charting their opponents. I wonder if this is necessary or good. At that age I would hope that winning matches is not the goal of the program. I think we in the United States have gone a little too far in regimenting the play of young people. Discipline is definitely required and a structured environment with a coach is a good way of fostering it. But, once on the court, I would like to see coaches move to a neutral corner of the gym and leave the matches to the team captains. And I would also like to see team captains rotate from time-to-time to give each player a chance to lead and a chance to follow. I think that taking a chart of youth matches is fine providing that it is a player who is asked to take the chart, either of his own team or that of an opponent. This is another kind of

May 2002: Please note that since the creation of this text, the rules of volleyball have changed dramatically.

While many of the concepts discussed here are probably still valid, specific implementations may need significant revision. In addition, many hyperlinks may no longer be available. --- Ravi Narasimhan

mental discipline that may help the player to better understand, appreciate, and assimilate what the coach is trying to communicate.

That being said, I enjoy and appreciate comments and opposing views. I can be reached via the Internet at oski@physics.ucla.edu .

Acknowledgments:

In addition to Fred Sturm, I thank Andy Read for helping me improve my knowledge of the game and charting techniques. Several examples in the tutorial are based on my personal charts of Stanford University matches and are presented with the approval of Stanford Women's Volleyball Coach, Don Shaw. I thank Rich Kern for his thorough and patient reading of several versions of this work. John Kessel, Rick Capone, and Joe Arkin have similarly made substantial editorial contributions to this and previous editions.

Caveats:

This tutorial is a personal statement by its author and is supplied to the community as such. Permission is given to copy and distribute this document providing:

- **It is reproduced in its entirety especially with the first and last page clearly visible (including this section)**
- **It is not used for any commercial purpose**

The charts of Stanford University's matches reproduced herein are subject to NCAA regulations on the sharing of information among member schools. These charts may not be excerpted or otherwise copied for use without the expressed permission of the author and Coach Don Shaw of Stanford University or his representative.

This document and its partner containing blank charts were created with Microsoft™ Word 6.0 on an Gateway 2000™ Computer running the Microsoft Windows 3.11 Operating System™ . The document files have been checked for the Concept virus as well as by a general virus checker and found to be clean and uninfected. **No warranty is implied or given.** This document is not endorsed, sanctioned, or otherwise under the aegis of the University of California, any of its campuses, or departments.