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Page 1 (cover page)
Tracks of the Past & Visions of the Future
(at UMC Dept of CS:Research, Education & Service)

Page 2 : Past Now Future

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I am very happy and honored to to be here.

The purpose of my talk is simple: to show you that I
have enough credentials and vision to lead this department
to reach a higher status in research, education and service.

My talk consists of two parts: PAST and FUTURE.
In PAST which includes NOW, I will show you my credentials.
In FUTURE, I will show you my vision for this department
and my plan to realize that vision.

Hopefully, at the end of the talk, you would say,
yes, I am convinced.

Page 3 : My Research areas: ...

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As the co-owner of a successful hi-tech software company
for more than 10 years,
I also have extensive experience in industrial R&D and

entrepreneurship.
So, I have in-depth knowledge of research in both the academic and private sectors.

Page 4: Reseach record: 120 research papers ...

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Finish the slide then say:
I am the sole PI of 22 of these 26 grants.
I have been Continuously supported by NSf for the past 13 years
I have also been funded by Fortune 500 companies: such as IBM, Ford, Honda (2), Olympus
Some of them are quite large, including my own business.
Hence, in addition to writing proposals and managing research projects, I also have extensive experience in leading and supervising research projects.

Page 5 : Important Research Contributions ...

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I have made important contributions in both areas.

1. I was the first person to develop hardware device to generate/render parametric curves and surfaces [79]. This work won me the prestigious Dr. Sun Yat-Sun Technology Invention Award.
2. My joint work with Ardy Goshtasby: "A Parallel B-Spline Surface Fitting algorithm" [45] initiated

a new research area, parallel spline algorithms.
The area is still active today.

3. The best result in this area was obtained by me, by showing that constant time complexity is possible for parallel B-spline surface interpolation [34].

Page 6 : Continue on Contributions ...

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4. Together with Brian Barsky at Berkeley, we developed the so called "Interproximation" technique, a combination of "interpolation" and "approximation".
5. Working jointly with Bill Luken, I developed the most efficient trimmed NURBS surface rendering technique for IBM.
6. I was the first person to work on constrained scaling techniques on NURBS and subdivision surfaces. These techniques make the redesign process of a car or an appliance much simpler and, consequently, can save those industries money and time in making changes to an existing model.
7. I have also worked extensively on subdivision surfaces. One of only a few who have played critical role in this area.

Page 7 : Professional recognition:

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During the past 8 yrs, I have been an NSF panel member
6 time and 3 of them are for CAREER awards.
I am currently an editor of two international journals.
I have been a program committee member for more than
20 international conferences.
This year along, I am a committee member of
4 international conferences.
So, I have built a reputation among peers in my own
research areas.

Page 8 : Current Research Projects:

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Currently, I am working on 4 research projects.
Most of them involve subdivision surfaces.
Two of them are funded by NSF. I am the PI of three
of them. The first one, Virtual 3D Plastic Surgery,
is challenging because it requires techniques from
several different disciplines: plastic surgery,
compute science, micro-biology, physics, ... etc.
This is a very exciting project because its impact can
be seen immediately and can change the lives of many
people.
(include the two figures I sent Shuhua here)

Page 9 : Blending and warping

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Here is an example of what virtual plastic surgery
can do for you. This is a simple application of
blending and warping techniques.

Page 10 : Morphing and boundary reshaping

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Another example of what virtual plastic surgery
can do for you. This is a simple application of
morphing and boundary reshaping.

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page 11 : My research interests:

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My research interests center around the design of
graphics and geometric algorithms,
with special emphasis on the modeling of geometric
shapes and computation techniques for rendering
and geometric problems.
The work spreads over 23 subject areas.

Page 12 : Recent focus: subdivision surfaces

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My recent research focuses on subdivision surfaces,
the de-facto standard for generating freeform curves and
surfaces of arbitrary topology in visualization and
animation applicaitons

I will show you some of my work in this area.

Page 13 : Applications of SSs

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Subdivision surfaces are used almost everyehere
now: graphical modeling, games, and animation.

Page 14 : Commercial packages

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Actually,
Subdivision surfaces have already been used by major commercial software as primary representation scheme, such as: Pixar's Renderman, ...

Page 15 : What is a SS?

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Subdivision surfaces have several different forms.
But, just what is a subdivision surface?

Page 16 : Def of a SS

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Given a control mesh and a set of refining (subdivision) rules, a subdivision surface is generated by iteratively refining (subdividing) the control mesh to form new and finer control meshes.

The mesh refining process consists of defining new vertices (face points, edge points and vertex points) and connecting the new vertices to form new edges and faces of a new control mesh.

A subdivision surface is the limit surface of the refined control meshes. The limit surface is called a subdivision surface because the mesh refining (subdivision) process is a generalization of the uniform B-spline surface subdivision technique.

Subdivision surfaces include uniform B-spline surfaces and piecewise Bezier surfaces as special cases.
Actually subdivision surfaces include non-uniform B-spline surfaces and NURBS surfaces as special cases as well.
Therefore, this is the most general surface representation scheme we have so far.

Page 17 : Why are SSs so special?

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Subdivision surfaces are special
Because subdivision surfaces can do things other
can not.

Page 18 : One piece rep

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You can represent any shape with just one subdivision surface because there is no limit on the topology of the control mesh of a subdivision surface.

Page 19 : Boolean operations

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including the results of Boolean operations

Page 20 : Why is one-piece rep good?

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One piece rep avoids the so-called "crack" (or, gap) problem.

With multi-piece rep, you will always get cracks no matter how precisely the Boolean operation is perfromed.

Page 21 : Multi-resolution

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Subdivision surfaces are good for internet data transmission because subdivision surfaces are scalable (i.e., having multi-resolution property)

Page 22 : Real-time scaling (multi-resolution)

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such as this example. Since there is always something on the screen, the user would not get bored.

Page 23 : Cover both reps

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Subdivision surfaces cover both polygon form and parametric form. These might not seem so important to you, but they are important to people in design and manufacturing.

Polygon form is good for machining, finite-element mesh generation, and manufacturing.

Parametric form is good for design and representation.

Therefore, you have a rep scheme that is good for almost anything.

Page 24 : Features

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Can model any kind of special features: sharp eges, sharp corners, creases, darts, ..., anything, through modifying the refining rules or repeating vertices or edges.

Page 25 : One thing is missing (keep the LR corner blank initially. Then do a fly-in on CAD/CAM)

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Nevertheless, subdivision surfaces have not been used by one industry yet. Which industry?

Page 26 : CAD/CAM.

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CAD/CAM.

Page 27 : Why?

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Why?

Because for quite a while people did not know how to parametrize subdivision surfaces, and there were no error control mechanism and adaptive subdivision techniques for subdivision surfaces either.

Page 28 : Slide 25

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These techniques are important.

Without error contorl, we can not ...

Without parametrization techniques, we can not do things such as ...

Without adaptive subdivision techniques, subdivision surfaces are simply too expensive to use.

Page 29 : Works on SS parametrization

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Things started to change in 1998.

J. Stam presented the first parametrization technique for Catmull-Clark subdivision surfaces.

Zorin et al presented parametrization technique for Loop subivision surfaces in 2002.
We presented a new parametrization technique for Catmull-Clark subdivision surfaces this year.
Why is a new technique necessary?

Page 30 : Applications of new technique

For one, the new technique is an explicit representation, you don't need a look-up table to get the value of a CCSS at a given point.
Second, the new technique uses only half the number of eigen basis funtions in the representation.
Therefore, the new parametrization technique is not only more efficient, but can also be used to compute tangent and normal of a subdivision surface at any given point.
Therefore, several things are possible now, such as ...

Page 31 : Surface Evaluation

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You can compute the EXACT value of a subdivision surface at any point of the parameter space now

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Page 32 : Texture mapping

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You can do texture mapping in a uniform way
The one on the left might look more impressive,

but it is the one on the right that is more difficult to do (to keep all paterns in a uniform size everywhere)

Page 33 : Texture mapping 1

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Can handle objects with holes as well.

Page 34 : Boolean operations

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Boolean operations can be done more precise and more efficient

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Page 35 : Boolean operations 1 (real time)

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Most importanrly,
boolean operations can be performed in real time.

Page 36 : Trimming

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Surface trimming is basically a surface intersection process.
With the new parametrization technique, it can be done as efficiently as Boolean operations.

Page 37 : Adaptive tessellation

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With the new technique, it is possible to have near-
optimum tessellation technique for rendering process.
The conformty requirement is not an issue at all.

Page 38 : Animation (fat horse)
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Crack free, real-time animation is possible because the computaiton process is more efficient now and the representation is one-piece.

Page 39 : What is error control? Slide 40
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Error control is the main factor if a representaiton
sheme can be used for CAD/CAM

Page 40 : Building bridge between two reps
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Error control technique builds a bridge between the
parametric rep and the polygon rep.

Page 41 : The problem is solved
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We have solved this problem completely with three papers,
for both regular patches and extra-ordinary patches.
This is the first one.

Page 42 : Adaptive subdivision

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The adaptive subdivision problem was solved earlier (2004)

Page 43 : Adaptive subdivision 1

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Here is an example that will show you a rep precise enough (within the given tolerance) but much less elements in the tessellated result.

Page 44 :

"Subdivision Surfaces: A representation scheme for all graphics (including visualization and animation) and CAD/CAM applications"

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Subdivision surfaces, as I have pointed out at the beginning, are quickly becomeing the primary rep scheme for all graphics (including visualization and animation) and CAD/CAM applications.

We are happy that we are part of the team in making this happen.

Page 45 : Acknowledgement

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Our effort in this area is mainly supported by NSF.
This is the past. Actually part of NOW too.

Page 46 : Future???

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What is the future?

Page 47 : The Future

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A new Chairman should have vision for the
Department's future.

So what is my vision? To talk about vision, we need to know what we are facing.

The world we are facing now is a more inter-disciplinary and more collaborative.
The problems we need to solve today usually require techniques from several different disciplines, such as problems in bioengineering or bioinformatics.
Therefore, communication and transition of ideas and results between different disciplines must be based on a language that people can understand.

Visualization techniques are obviously the easiest way

and most efficient way to communicate ideas and results between different disciplines.

Another important issue is Internet computing.
Internet, one of the most important inventions of human being, has simplified and improved our lives in many ways.
But it also introduced many new problems including spam, viruses/worms, digital copyrights, identity theft, electronic fraud, electronic warfare, etc.
Solving these problems are not easy at all because this is not just a technology problem, It will take people from several different disciplines, including educators, policy makers, business people, and lawyers.
CS people play a crucial component here because we are the people who design and perform the actual work.

There are other problems as well. What we can see is, computing today has reached a point that only those who know how to use internet computing as a core and visualization techniques as a communication means to integrate/combine different computation models and computation tools to solve multidisciplinary problems in urgent areas such as security and public health will excel.

Page 48 : Vision for the Department:

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This is my vision of this dept for this millennium.

Page 49 : General mission:

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Our general mission is to ...

But our most urgent mission is to ...

Page 50 : Action Plan for Research:

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We need an Action Plan for each of the Research, Education and Service Areas.

My action plan for research include the following items.

1. ... 5.

6. Pushing for creation of technology centers in the college such as
   - Center for Visualization and Virtual Environment
   - Center for Internet Computing
   - Center for Bio-Informatics

The importance of these items is not necessarily sorted in this order, but I do believe the first item is the most important thing we should do.

I will (briefly) address these items separately in the following, starting with item 3 because information used for this item will be used by item 1 too.

Page 51 : 3. Build selective areas of excellence

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It is well known that the top CS Depts are much larger.
E.g., MIT's no 1 ranked CS program has 91 faculty.
Standord's no 2 ranked CS program has 51 faculty.
CMU's no 3 ranked CS program has 48 faculty.
Berkeley's no 4 ranked CS program has 46 faculty.
Cornell's no 5 ranked CS program has 50 faculty.
An they all have large number of PhD students and annual PhD graduates.

Page 52 : Small CS programs can be highly renked too

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The good thing is, one does not (always) have to be large to be highly ranked
Small CS depts can be highly ranked too.
E.g., CalTech's no 15 CS program has 15 faculty members only.
Rice University's no 19 CS program has 18 faculty members only.

Page 53 : Key: growing selective areas of excellence

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The key to improve in rankings and reputation is through growing selective areas of excellence.

A higher ranking would not only attract more high-quality students to our department, but also increase our chances in getting external supports.

We will continue to expand the strength of all our existing research areas, but we will put extra resources into two or three selected areas that have the best chance to excel nationally.

Page 54 : 1. Increase Research Funding

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One thing in common for all these top CS departments is, they all have good size of research funding per faculty member.
Each faculty at MIT has $685,000 per year.
Each faculty at Stanford has $730,000 per year.
The smaller depts,
such as CalTech has $500,000 per faculty per year.
Even Rice has $350,000 per faculty per year.

Page 55 : Significantly increase external funding

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For us to improve reputation and rankings, the most important issue would be to significantly increase the funding of this dept, whatever it takes.

We will encourage faculty to write more high-quality research proposals each year, and explore our opportunities with other federal agencies such as Army, Homeland Security Dept, NIH and private companies such as ....
We will use Missouri Senators and Congressmen's offices to build connections especially with Army and HLSD.
These are the places with huge amount of cash to spend.

Page 56 : 2. Increase the quality of Publications
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Each faculty member should try to publish 3 journal papers and 3 conference papers in high quality journals and conferences.

We will create a list of top-tier journals and conferences and second tier journals and conferences in various research areas and faculty members will be evaluated based on the quality of their publication.

We encourage faculty to publish half as many papers in top-tier journals and conferences than twice as many papers in second-tier journals and conferences.

Page 57 : 4. Larger startup funding for new faculty hires
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Larger startup funding is necessary to compete for
excellent new faculty members.
It is also necessary for new hires to quickly build
up a strong research team to compete for professional
visibility and to compete for CAREER awards.
We should know that to build a larger research enterprise,
we need to invest in research resourses.
We will work with the College to increase the startup
funding by 50% at least.

Page 58 : 5. Increase the number of PhD students

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I will address this issue in the Education part.

Page 59 : 6. Technology centers

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The sixth item is to push for creation of technology centers in the college such as

Center for Visualization and Virtual Environment
Center for Internet Computing and Security
Center for Bio-Informatics

Page 60 : Technology centers I

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Technology centers have several advantages that allow us
to build stronger research ties with industry.

First, a technology center can provide combined strength of several areas. Therefore, a technology centger can handle technical problems in a broader range.

Second, the cost structure of a technology center is low because faculty associated with the center usually are not paid by the center and the students working there are paid much less than professional engineers.

So it is cheaper for a company to out-source its research projects to a technology center than doing the projects themselves (or out-sourcing to India or China).

This "Technology Center" model has been working successfully at several places, including U Southern California's Information Sciences Institute, Johns Hopkins' Applied Physics Lab, and Georgia Tech's GTRI.

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page 61 : Education in general:

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The challenge universities are facing now is the same: a world that is more INTER-DISCIPLINARY, COLLABORATIVE, and GLOBAL.

Computer Science Depts of this century need to produce students who are more adaptable and flexible, besides being technically proficient.

This is true for both undergraduate and graduate education.

Page 62-1 : Action Plan for undergraduate education:
1. Increase the number of undergraduate students
400 (2006) -> 500 (2010)
--
My Action Plan for Undergraduate Education includes the following items.

The first plan is to increase the number of undergraduate students from 400 currently to 600 in 2010.

It has been a national trend that the number of students attending CS and CE is declining.
But the total number of students interested in these disciplines is still very large natinally and in the state of Missouri.
We should market our undergraduate program to the large number of prospective students in the state of Missouri and midwest.
Need to redesign our website.
If we can let a student know more about our strength, we have a better chance to recruit that student into our program.
Providing an informative website is the cheapest and, yet the most efficient way, to recruit students.

Page 62-2 : 2. Improve the quality of undergraduate students

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Quality certainly is more important or as important.
Our next plan is to increase the quality of
undergraduate students. We need to attract more
excellent high school graduates to UMC.
The first thing we will do is to raise funding
for undergraduate scholarships in CS.
Other actions include organizing state-wide promotion
trips to high schools to talk to students directly,
and providing more information about our program
on our website.

Page 62-3 : 3. Get the undergraduate program accredited
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I was a member of the ABET committee of UK's CS Dept.
I was involved in every detail of the preparing process.
So, I have enough experience to lead such a process here.
This might not be as urgent, but it needs to be done
eventually.

Page 62-4 : 4. Develop Certificates
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I consider the job of a programmer a manufacturing job.
A company would out-source it if at all possible.
So, in addition to giving the students a good training
on computer science in the broad sense, we should also

give them a chance to be more specilized in one or two areas, in a sense, giving them something that can not be out-sourced to a foreign country yet.

We do this by creating, for instance, certificate in vision/ graphics, networking or bio-infromatics.

The students take some extra curricula to get the certificate.

With a certificate, a student would not only have an edge when looking for a job, but also has less chance to be laid off because of the extra stgrength.

I am currently responsible for developing a certificate in vision/graphics for UK's CS dept. So, I have experience to lead such an effort here too.

Page 62-5 : 5. Get our seniors involved in the research

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In addition to increasing the width of the students knowledge, we should also increase the depth of their hands-in capability.

Our students must be able to design, not just implement.

They must be able to solve multi-displicinary problems.

By looking at your course list, I can tell that with CS4970, CS4980, CS4990, CS4995, there is already such an effort in that direction in this dept.

But we can do more by requiring the projects of those courses to be involved with at least one of the faculty's research grants.

Page 63 : Action Plan for graduate education:

1. Increase the number of PhD students
   45 (2006) -> 65 (2010)

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To improve graduate program, recruit and retain excellent graduate students, our first action is to increase the total number of graduate students from 80 (2006) to 100 (2010), but with a favor in more PhD students.
Currently the number of PhD students is about 45 (2006). That number should be increased to 65 (2010).

This goal will be achieved by attracting more graduate students into our PhD program through the following steps:

(a) PhD students have the hightest priority to be supported
(b) A PhD student with a MS in CS before joinning the PhD program can not get a MS degree here if they change their mind after joining our PhD program
(c) do not support MS students with TAships or Fellopships
(d) Increase RA positions for PhD students by increasing our external research funding by 100% by 2010.

A more informative website should also be used to make recruiting graduate students more effective.

Page 64 : 2. Improve the quality of PhD students

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We will improve the quality of graduate students by

(a) encouraging our good MS students to apply for our PhD program

(b) we will try to provide paid summer internships, 6-month or one-year internships to top CS juniors or seniors at top universities in China, India, Taiwan, Korea, ... with dept fund.
Once a student is familiar with our department, especially when a student likes his/her research experience here, we have a better chance to recruit him/her back into our PhD program. I got this idea from the internship program of MicroSoft Research Center in Beijing (called MRCA). Their internship program not only created excellent research results (those students made siginficant contribution to the research work of MRCA by publishing papers in prestigious conferences like SIGGRAPH, ... etc), but also provided them with an influx of excellent new employees becuase most of those students joined MRCA after they graduated from their colleges.

(c) our PhD student stipends must be competitive.
We will make sure our PhD students are paid at least as much as our benchmark universities.

Pge 65 : 3. Improve the retention and graduation rate

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We will (a) develop a more exciting and flexible curriculum
for our graduate program.
We will consolidate courses in the curriculum so that
MS and PhD curriculum is not spread over too many
courses.
This will make sure most of the courses are offered
at close to full capacity so that there will be no
need to cancel any courses.
We will (c) ensure every PhD student gets proper
financial support

Page 66 : Action Plan for Service:
(academic and professional service)
(advising undergraduate and graduate students)

--

Service is also a very important mission of us.
The Chairman of the dept should work closely with DGS
and DUS to ensure every student gets proper advice
for every thing related his/her study in the
department. In particular,

(a) To make the advising process more efficient for us and
the students as well, we will consider the possibility

of doing group advising, i.e., instead of meeting with the students individually, we provide a chance for all the advisors to meet with all the advisees in an advising area at the same time so that one trip is all it takes for everybody.

(b) For graduate students who do not have a permanent supervisor yet (the duration of that time sometime could be as long as two years), the department should assign a temporary advisor to each graduate student to help with his/her academic problems.

(c) We will hold regular meetings (at least once a semester) to discuss the progress of our MS students and our PhD students. Each advisor, permanent or temporary, is responsible for reporting the progress of his/her advisees so the department (DGS) can make proper decision on the next stage for each student. These meetings also determine if a student should be financially supported by the department subsequently.

Page 67 : Action plan for Service I

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To increase the visibility of the dept, dept chairman encourages faculty to get involved more in professional acitivites.

(d) The dept will provide administrative support
within its power to faculty who are involved in
professional acitivities such as conference
chairman, program chairman, editor-in-chief, ...

(e) The dept will help faculty to seek financial
assistance from the university or external sources
to hold conferences and symposiums on campus or
in St. Louis area.

Page 68 : Action Plan for Administration:

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As far as administration is concerned,
I will follow the leadership of previous chairmen to
continuously provide transparent, efficient administation
and efficient staff. I will

(a) revise dept Operating Rules and Procedures
if necessary
(b) ensure policy making within the department is as
pransparent as possible, through various committees
(executive committee, hiring committee, graduate
committee, undergraduate committee, equipment committee)
and faculty meetings, using a bottom-up approach whenever
it is possible.
(c) Review the administrative and technical support

structures to make sure the department has sufficient support in both areas

(d) Improve the morale and effectiveness among the staff members by providing appropriate recognition and competitive salaries to all staff (administrative or technical) (compared to our benchmark universities)

Page 69 : In summary,

I want to make this department a great department:

- a department with a bracing atmosphere,
- a department with a strong sense of community,
- a department with intellectual vigor and, most importantly,
- a department that everybody can reach his/her full potential.

I eagerly & sincerely hope I have a chance to achieve these goals.

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This ends my presentation. I will be glad to answer questions.