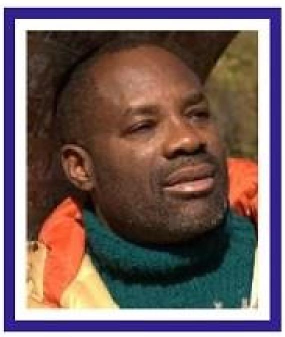
44 How I Solved the Toughest Problem in Calculus—Part 2 of 15



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44.1 They Called Me ‘Calculus’

44.1.1 Toughest Problem in Calculus

I'm **Philip Emeagwali**.
Back in 1989, I was the cover stories
of top mathematics publications.
I was cover stories because
I invented
how to solve the toughest problems
that arose in calculus, algebra,
and physics
and how to solve them
by parallel processing them
across a new internet
that is a new supercomputer
and a new global network of
65,536 commodity processors.
Historically, the speed of solving
the toughest problems
arising in calculus, algebra, and physics,

2066

is the singular yardstick
for measuring contributions
to the development of the computer.
The reason is that the
massively parallel processing
supercomputer
is not only about satisfying curiosity
or about doing well.
The modern supercomputer
is about doing good, too.
I define the supercomputer
as a calculating machine
that can be programmed
to solve the toughest problems
that are listed
as the 20 grand challenges
in science and engineering,
and, specifically, to solve those problems
65,536, or more times,

faster than the computer.

44.2 The New Way of Doing Mathematics

I'm different from
one million modern mathematicians.
I'm different because
I perform my arithmetical computations
in parallel,
or multiply 65,536
pairs of numbers
at once.
I'm different because
modern mathematicians
perform their arithmetical computations
and do so in sequence,
or multiply two numbers at a time.
I'm different from the pure mathematician
that uses the blackboard
as his mathematical canvas.

I'm different because
I'm an extreme-scale
computational mathematician
who abandoned his blackboard
and embraced a new internet
that he invented
as a new global network of
64 binary thousand motherboards
and embraced those motherboards
as his mathematical canvases.
I'm different from the
applied mathematician
that applies a real world
mathematical problem
—such as a general circulation model
for global warming—
and applied it
as his backdrop.
I'm different because
I applied both the mathematics
and the problem

as the backdrops
to the new internet
that I invented
as a new global network of
64 binary thousand
processors.
I’m different
from the computational mathematician
that only uses one motherboard
as his mathematical canvas.
I’m different because
I used a new internet
that is not a computer *per se*
and used that internet
as my mathematical canvas.
I’m different because
I was the only research mathematician
that was profiled in the book titled:
“History of the Internet.”
Please allow me to quote
from the book

"History of the Internet." 2070

[quote]

In 1989 mathematician Philip Emeagwali shocked the supercomputer industry by performing the world's fastest computation—3.1 billion calculations per second—using the power of Internet. The results, as computer scientist Marsha Lakes put it, were "phenomenal . . . three times faster than a supercomputer."

[unquote]

My contribution to mathematics
is this:
I changed the way
we do computational mathematics.
In the old way,
we computed on only one isolated
processor
that was not a member
of an ensemble of processors,

or within only one isolated computer
that was not a member
of an ensemble of computers.
In my new way, the **Philip Emeagwali** way,
I computed **across** millions
of commonly available processors
that shared nothing with each other,
or **across** millions of computers.

44.2.1 Contribution of Philip Emeagwali to Calculus

I am an extreme-scale
computational mathematician
that conducted his decade-long
supercomputer experiments alone.
I did my high-performance supercomputing
across a new internet
that I invented
as a new global network of
65,536 processors

that were already available in the market 2072
and that is a small copy
of the Internet.
I used my new internet
to **experimentally confirm** that
65,536 days, or 180 years,
of **time-to-solution**
can be compressed to only one day
of **time-to-solution**
and compressed **across** a new internet
that is a new global network of
65,536 tightly-coupled processors
that shared nothing with each other.
I—**Philip Emeagwali**—
was the lone wolf
research supercomputer scientist
in Los Alamos, New Mexico, United States,
in the then uncharted territory
of the massively parallel processing
supercomputer.
I was in major newspapers,

such as the June 20, 1990 issue
of the *Wall Street Journal*,
because I **invented**
how to parallel process
and invented
the massively parallel processing
supercomputer
and invented the technology **across**
65,536 tightly-coupled processors
that shared nothing with each other.
I invented
the massively parallel processing
supercomputer
and I invented the technology
when everybody else said that
parallel processing, or computing
65,536 things at once,
will forever remain
a huge waste of everybody's time.

2073

44.2.2 Rejections of my Discoveries

2074

In the 1970s and ‘80s, my quest
was for how to **harness the power** of
the massively parallel processing
supercomputer.
My goal was to **harness that power**
and use it
to solve the toughest problems
arising in computational physics,
modern calculus, and extreme-scale algebra.
On the Fourth of July 1989,
I invented
how to **harness that**
massively parallel processing power
and how to use it
to perform the fastest computations
and how to use that unheard of speed
to solve
the most computation-intensive problems
arising in supercomputing.

2075

My supercomputer research
on how to harness the power
of 64 binary thousand tightly-coupled
processors that were already available in the market
was ridiculed and rejected
as a huge waste of everybody's time.
In the 1970s,
I was humiliated
by sequential processing supercomputer research teams.
In the 1980s,
I was humiliated
by vector processing supercomputer
research teams.
I was humiliated
because I advocated
that the massively parallel processing supercomputer
will become the fastest computer
in the world.

I was **dismissed** 2076
from supercomputer research teams
because I preached that
the modern supercomputer
should do many things in parallel,
or **at once**.
The reason cited for the rejection
of my massively parallel processing
supercomputer research
was akin to that given in an article
in the June 14, 1976 issue
of the *ComputerWorld*.
The *ComputerWorld*
was the flagship publication
of the computer world.
That *ComputerWorld* article
was titled:
[quote]
“Research in Parallel Processing
Questioned

as “Waste of Time.’”
[unquote]

44.2.3 Sixteen Years to Make the Impossible Possible

In the 1970s and ‘80s,
the leaders of thought
in the world of supercomputers
dismissed parallel processing
as a beautiful theory
that lacked an experimental confirmation.
The reason my invention
of the massively parallel processing
supercomputer
made the news headlines
in 1989
was because the supercomputer textbook
of 1989 and earlier
wrote that it will be impossible
to parallel process
the toughest problems.

That is, it was impossible in the 1980s 2078
to massively parallel process
extreme-scale global climate models.
Global climate models must be executed
at the fastest supercomputer speeds
and must be executed
to more accurately foresee
future global climate changes.
In the 1980s, it was impossible
to execute global climate models
and to execute them **across**
as much as an ensemble
of eight co-operating processors.
That limit of eight processors
and eight-fold speedup
was described in supercomputer textbooks,
of the 1980s and earlier,
as Amdahl's Law limit.
On the Fourth of July 1989,
I invented
how to solve the toughest problems

arising in extreme-scale
computational physics—such as
excruciatingly detailed,
larger, higher-fidelity
petroleum reservoir simulation.
I invented how to solve
such computation-intensive problems
and how to solve them
for their highest resolutions
and how to solve them in parallel
and how to solve them **across**
a new internet
that is a new global network of
two-raised-to-power-sixteen,
or 64 binary thousand tightly-coupled,
processors
that were already available in the market
and that shared nothing with each other
and that is a new supercomputer
and that is a new computer.
In the world of the supercomputer,

to discover or invent a new supercomputer
that is a new computer
is to show that
the **impossible-to-compute** is,
in fact, **possible-to-compute.**
I—**Philip Emeagwali**—was in the news
back in 1989
and in the June 20, 1990 issue
of the *Wall Street Journal*.
My experimental discovery
of a new supercomputer
was in major U.S. newspapers
because I did the impossible
and did it on a never-before-seen
supercomputer machinery.
At the frontier of supercomputer knowledge,
50 percent of what is considered impossible
is, in fact, possible.
With the passage of time,
the impossible can become possible
and become possible

as our body of scientific knowledge grows
and become possible
as our body of technological knowledge
grows.
The other 50 percent
of what is considered impossible
will forever remain impossible.
That 50 percent
will forever remain impossible
because it violates
the laws of physics,
and violates them
in the manner the perpetual motion machine
violates the first law of thermodynamics
called the law of conservation of energy.
Often, it takes extraordinary diligence,
intellect, knowledge,
and a never-before-seen machinery
to show that
the impossible is, in fact, possible.
It took me fifteen years,

onward of June 20, 1974,
to invent
how to massively parallel process
and how to process **across**
a new internet
that is a new global network of
64 binary thousand
tightly-coupled processors
that shared nothing with each other,
or how to process **across**
as many tiny computers.
For the sixteen years
onward of June 20, 1974
and from the Computer Center
at 1800 SW Campus Way,
Corvallis, Oregon, United States,
I programmed supercomputers
and I did so continuously and almost daily.
I programmed supercomputers
that were powered by
only one **isolated** processor

that was not a member
of an **ensemble** of processors. 2083
I programmed supercomputers
that were powered
by up to 65,536 processors.
I programmed supercomputers
as a lone wolf supercomputer scientist
in the then uncharted territory
of the massively parallel processing
supercomputer.
At 8:15 on the morning
in Los Alamos, New Mexico, United States,
I invented
the massively parallel processing
supercomputer.
I invented that technology **across**
a new internet
that **I invented** as my new global network of
two-raised-to-power sixteen
tightly-coupled processors
that shared nothing with each other.

44.2.4 The Myth About Math Geniuses

It's a myth that only **brilliance**
is required
to become a supercomputer genius
that invented a never-before-seen
supercomputer.
Talent is a necessary condition
but is not a sufficient condition
for solving the toughest problems
arising in modern calculus
and in extreme-scale computational physics.
It is my twenty years of diligence
in acquiring
the multidisciplinary knowledge
that spanned mathematics, physics,
and computing
that made me
the supercomputer scientist
that I am today.

In the 1980s,
there were 25,000 **brilliant**
vector processing supercomputer scientists
in the world
that were led by **Seymour Cray**.
Yet, only one supercomputer scientist
had the courage, the confidence
and the scientific
and technological knowledge
that was needed
to massively parallel program alone
and that was needed
to parallel process **across**
a new internet
that is a new supercomputer
that is a new global network of
65,536 processors.
I—**Philip Emeagwali**—was the only
supercomputer scientist
that had the courage, the confidence
and the knowledge

that was needed to **harness** 2086
the parallel processing
supercomputer power
that was hidden
inside the one and the only
most massively parallel processing
supercomputer in the world
that was ever built.
Only one such supercomputer
was built.
And that new supercomputer
only allowed
only one fulltime programmer
at a time.
That one-of-a-kind supercomputer
was powered by
65,536 tightly-coupled processors
that shared nothing with each other
and that I visualized as
metaphorically located
at the 65,536 vertices

2087

of the hypercube
in my imaginary
sixteen dimensional universe.
I visualized those vertices
as equal distances **apart**
and on the fifteen dimensional hypersurface
of the hypersphere
that tightly circumscribed
that hypercube in hyperspace.
Inside the supercomputer room
are the cabinets,
inside the cabinets
are the racks,
inside the racks
are the boards,
and on the boards
are the chips.
I—**Philip Emeagwali**—
was the massively parallel processing
supercomputer scientist
that was the lone voice

2088

in the wilderness
of the then unknown world
of parallel processing supercomputing.
In my vision
and as the primal programmer
of a primordial internet,
I saw those processors
as 65,536
equidistant search lights
around a global sky.
I saw those search lights
as three thousand square miles **apart**.
I saw those search lights
pointing towards
the darkest corners
of human understanding
of global warming
and global issues.
I was that lone wolf
supercomputer scientist
and the only fulltime programmer

that could and did program
that massively parallel processing
supercomputer.
I made headlines in major U.S. newspapers
because I invented
how to **harness** the supercomputer power
of two-raised-to-power-sixteen
processors
that were already available
in the market anyway.
Or how to **harness** as many
identical computers
and **harness** them
to execute the most computation-intensive
floating-point arithmetical operations
that arises in computational physics.
Those arithmetical operations
arose from solving the most large-scale
system of equations
arising in algebra.
Those algebraic problems

approximated 2090
the initial-boundary value problems
arising in calculus and physics.
Those initial-boundary value problems
encoded the laws of physics
that were at the granite core
of the branch of physics
that is called
computational fluid dynamics.
I invented
how to **harness** the total processing power
of millions upon millions
of tightly-coupled processors
that shared nothing with each other
and how to **harness** them
to solve the toughest problems
arising in physics, calculus, and algebra.
And after sixteen years
as a lone wolf supercomputer programmer,
the news media discovered me
as the African Supercomputer Wizard

in the United States.
So it was a myth
that I was the new kid
in the uncharted territory
of massively parallel processing,
the critical technology
that is the core essence
of the modern supercomputer.

44.3 How I Invented Philip Emeagwali's Equations

44.3.1 On Becoming a Supercomputer Genius

The invention of the paradigm-shifting
massively parallel processing supercomputer
is rarer
than the writing of the complete works of
William Shakespeare.
In the history of computing,

the parallel processing supercomputer 2092
is the only paradigm shift
that was of **tectonic** scale.
The number of major scientific discoveries
and technological inventions
that can be made are **limited**.
However, the number of
minor scientific papers
that can be published are **unlimited**.
Our distant descendants
can write a billion novels
or a billion plays or a billion movie scripts.
But our distant descendants
cannot make an unlimited number of
groundbreaking scientific discoveries
and technological inventions.
In a lecture delivered on February 25, 1969
in Portland, Oregon,
Alex Haley, the author of
“The Autobiography of Malcolm X”
spoke about his

as-yet-to-be-published bestselling book 2093
that was later titled
"Roots"
and subtitled
"The Saga of an American Family."
Alex Haley said that
he wrote a million words
before he could sell his first piece of writing.
The teenage soccer prodigy
had kicked the soccer ball
a million times
before he played at the World Cup.
Back in 1972, a seventeen-year-old
named "**Philip Emeagwali**"
was mentioned in the science column
of the *Daily Times*.
The *Daily Times*
was then the only national newspaper
of my country of birth, Nigeria.
Back in the 1970s and '80s,
I wrote one million

mathematical expressions 2094
and wrote them from the **story**board
to the **black**board
to the **mother**board
and **across** a new internet.
I invented that new internet
as a new global network
of 64 binary thousand
already-available **mother**boards.
Yet, I didn't call myself
a supercomputer scientist
back on June 20, 1974,
when I began programming supercomputers.
I **experimentally programmed**
65,536 processors
before I called myself
a massively parallel processing
supercomputer scientist.
I called myself a supercomputer scientist
because the supercomputing community
acknowledged that I contributed

to the development of the
modern supercomputer
that computes in parallel.

44.3.2 Origin of Philip Emeagwali's Equations

My mathematical maturity
grew over the twenty years
onward of June 1970.
In those two decades,
I studied physics and calculus
and computing.
It was in June 1970
that I first wrote the iconic equation
of physics
F=ma, or **Force** equals
mass times **acceleration.**
I first wrote **F=ma**
as an eighth grader
at Christ the King College,

Onitsha, Nigeria. 2096
I wrote a hundred equations
for most days for twenty years
before I became **cover stories**
in the world of mathematics.
Contrary to the myths about
my overnight success,
I scribbled a million equations
on yellow pads
before I became **cover stories**
for the nine new
partial differential equations
that **I invented.**
As an aside, the nine
partial differential equations
that **I invented**
were my symbolic restatements
of nine algebraic equations.
Each equation was **F=ma**
for the three phases of crude oil, injected
water, and natural gas

and for the three spatial directions, 2097
named the x-, y-, and z-directions.
I encoded
the Second Law of Motion
of physics
into my system of
partial differential equations
of modern calculus.
I computed my algebraic restatements
of that calculus
and I computed them **across**
my new internet.
I invented my new internet
as a new global network of
64 binary thousand
tightly-coupled processors
that were already available in the market
anyway.
The system of coupled, non-linear,
time-dependent, and state-of-the-art
partial differential equations

of modern calculus
that is also known as
the nine Philip Emeagwali's Equations
did not pop into being
during one moment of Eureka.
The nine Philip Emeagwali's Equations
had their algebraic roots
in the Second Law of Motion
of physics.
That Second Law was discovered
back in the year
sixteen sixty-six [1666].
About two centuries ago,
research mathematicians
invented the technique
for **encoding**
the Second Law of Motion
into differential equations.
As a research mathematician
of the 1970s and '80s,
I didn't wake up one morning

and decided to invent
the Philip Emeagwali's
system of nine
partial differential equations
of modern calculus.
Inventing partial differential equations
is rarely the objective
of a research mathematician.
The reason I invented
the nine Philip Emeagwali's
partial differential equations
was because I could not equate
the four forces inside the oil field
to the three forces on the blackboard
and the three forces
in the textbooks and codes
for extreme-scale
petroleum reservoir simulation.
My contributions to mathematics
that was the cover stories
of top mathematics publications

is this: 2100
I invented
how to equate the physical forces
on the **story**board,
to the physical forces
on the **black**board,
to the physical forces
on the **mother**board,
and equate them **across** **mother**boards.
I invented
how to equate those forces
and do so by adding
a fourth force to those three forces
that were in the textbooks
on porous media flow.
Those three forces were
the pressure, viscous,
and gravitational forces.
The new four forces
are pressure, viscous, gravitational,
and inertial forces.

Those abstracted four forces
corresponded to the four physical forces
inside the oil field.
All mathematical physics textbooks
on the subject of flow of crude oil,
injected water, and natural gas
through porous media
had 45 partial derivative terms
that represented
the crude oil, injected water,
and natural gas phases
along the three x-, y-,
and z- spatial directions.
I invented
the nine Philip Emeagwali's
partial differential equations
that contain
36 additional partial derivative terms.
Those 36 mathematical terms
accounted for both the **temporal**
and the **convective** components

of the inertial forces
and accounted for
the crude oil, injected water,
and natural gas phases
in three x-, y-, and z-
spatial directions.
From my perspective,
the old, **parabolic**
partial differential equations
that were used by the petroleum industry
was a non-equation
that I called an inequality.
The partial differential equation
in porous media flow textbooks
that **encoded** the Second Law of Motion
of physics
was not an equation.
The reason it was not an equation
was that the **abstracted** forces
on the blackboard
were not congruent

to the physical forces inside the oil field
that they represented.
The nine Philip Emeagwali's Equations
are at the granite core
and at the mathematical foundation
of the toughest problem in calculus,
that is sometimes called
one of the grand challenge problems
in supercomputing,
namely, extreme-scale
petroleum reservoir simulation
across an ensemble of
commodity-off-the-shelf processors.
I mathematically discovered
that the three pieces
of the grand challenge puzzle
did not fit into the four slots
on the **story**board
or on the **black**board
or on the **mother**board.
I had to invent

my 36 partial derivative terms
to account for the fourth force,
namely, the temporal and convective
inertial forces.

44.3.3 My Mathematical Maturity Over Two Decades

A lesson I learned
during my twenty-year-long mathematical
quest is that I wrote
a million mathematical equations
before I contributed
my nine new partial differential equations
to modern calculus.
It was only after those twenty years
of considered meditation
on partial derivative terms
and a decade on the
36 new partial derivative terms
that encoded the temporal and convective
inertial forces,
that I invented my nine new

partial differential equations 2105
of modern calculus
that comprised of
81 partial derivative terms
of modern calculus.
The laws of physics
were the common denominator
across my two-raised-to-power-sixteen,
or 65,536, computer codes
that I emailed
to the sixteen-bit long email addresses
of my 64 binary thousand processors
that outlined my new internet
and defined my new technology
as my new supercomputer
that is a never-before-seen computer.
It was only after a decade of
careful judgement
on the laws of physics
that I experimentally discovered
how to email those codes
and do so **across**
sixteen times

two-raised-to-power-sixteen, 2106
or 1,048,576,
bi-directional, regular, short,
and **equidistant** email wires
that married 65,536
commodity-off-the-shelf processors
together
and electronically married them
as one seamless, cohesive whole
new supercomputer.
I took a decade
to invent how to solve
initial-boundary value grand challenge problems
of modern calculus
and how to solve those problems **across**
a new internet
that I invented
as a new global network of
64 binary thousand tightly-coupled
processors
that shared nothing with each other.
So after twenty years, and perhaps, seeing

and/or writing one million
mathematical expressions,
I grew from being a mathematician
that knew mathematics
to gaining public recognition
from mathematicians
and gaining it as a mathematician
that made contributions to mathematics.

44.4 The First Supercomputer and Philip Emeagwali's Equations

Supercomputer wizardry
is only earned by programming
the fastest supercomputers
and by programming them
day after day, year after year,
and even decade after decade.
On June 20, 1974,
the day I began supercomputing,
I was as insecure as the child
that was learning

how to ride a two-wheeled bicycle
and learning how to ride it
without the security of
stabilizer training wheels.

44.4.1 Philip Emeagwali Supercomputer Vision

My mathematical quest
was for new calculus
and for new algebra
and was to invent
how to solve the toughest problem
arising in calculus, algebra, and physics.
That mathematical quest
began on Thursday June 20, 1974
when I woke up
in a tiny room upstairs of a white house
at 195A Knox Street South,
Monmouth, Oregon,
in the Pacific Northwest Region
of the United States.
That mathematical quest

began at age nineteen 2109
and on one of the world’s
fastest supercomputers.
That supercomputer
was at 1800 SW Campus Way,
Corvallis, Oregon, United States.
For a wider and more diverse **perspective**,
we must see the
massively parallel processing supercomputer
that is the precursor
to the modern supercomputer
and see the technology
through the intellectual eyes
of its first lone wolf programmer
that programmed the machinery
for sixteen years,
and not see the technology
through the eyes
of a person that merely studied
supercomputers
and studied them
without programming supercomputers
in those sixteen years.

The author
of the supercomputer textbook
first learned that it is possible
to solve
the toughest problems
arising in calculus,
algebra, and physics
and learned how to solve
those grand challenge problems
in parallel
and learned it in 1989,
the year my experimental discovery
of parallel processing
made the news headlines.
I was the lone wolf programmer
of the precursor
to the modern supercomputer
that is described in supercomputer
textbooks.
The author of the supercomputer textbook
learned the most massively
parallel processing supercomputer
from I—**Philip Emeagwali**—

the first person
that invented
how to massively parallel program
the modern supercomputer
and how to use that new knowledge
to solve the most extreme-scale problems
arising in computational physics
and applied mathematics.
Because I programmed supercomputers
since June 20, 1974
and that I programmed supercomputers
as a lone wolf,
only I knew my original supercomputer
intention.
I visualized my new massively
parallel processing supercomputer
differently from others.
I visualized my new massively
parallel processing supercomputer
as a new internet
that is a new global network
of 65,536 already-available
tightly-coupled processors

that shared nothing with each other. 2112
I visualized those commodity processors
as my instruments of
computational mathematics
that I must harness
to execute the fastest
floating-point arithmetical calculations ever recorded.
I theorized my new massively
parallel processing supercomputer
as my primordial, room-sized internet
that is a small copy
of your terrestrial, Earth-sized Internet.
In a nineteen eighty-nine [1989] survey,
there were twenty-five thousand [25,000]
computational scientists
and programmers
with accounts
on conventional vector processing
supercomputers.
Those twenty-five thousand [25,000]
computational scientists
considered it a **waste of their time**

to use the massively parallel processing
supercomputer
and use that unorthodox technology
to solve
their computation-intensive
scientific problems.
After my invention
of the massively parallel processing
supercomputer
that occurred
at 8:15 on the morning
of the Fourth of July 1989,
and occurred
in Los Alamos, New Mexico,
United States.
That was the Eureka moment
that I experimentally discovered
how and why
the modern supercomputer
must compute in parallel
in order to simultaneously solve
millions upon millions
of the most grand challenging problems

arising in physics and mathematics,
instead of solving
only one grand challenge problem
at a time.

44.4.2 Solving the Philip Emeagwali's Equations

Solving the toughest
initial-boundary value problem
of modern calculus
that is at the foundation
of extreme-scale computational physics
calls for greater **synthesis**
and less **analysis**.
Unlike the polymath,
the research mathematician
is often misled by his analysis
that leads to his dreaded
dead-end **analysis paralysis**.
The solutions for the toughest
multi-disciplinary problems

that are defined at the crossroads
where planetary-scaled physics
met advanced calculus
and met extreme-scaled algebra,
and met fastest supercomputers
calls for the synthesis
of the new knowledge
that were discovered at the frontier
of extreme-scaled computational physics
and discovered at the frontier
of the partial differential equations
of modern calculus
and discovered at the frontier
of extreme-scaled algebra
and discovered at the frontier
of the fastest processors
and discovered at the frontier
of how to send and receive
64 binary thousand emails
and how to massively communicate
to and from
64 binary thousand processors
and how to send and receive

those 65,536 emails
and how to do so **across**
one binary million
bi-directional email wires.
The excruciatingly-detailed solution
of the initial-boundary value problem
that is used to discover and recover
otherwise elusive
and **unrecoverable**
crude oil and natural gas
did not call for the
analysis paralysis
of the nine **Philip Emeagwali**’s
partial differential equations
of modern calculus.
That solution
called for the creation
of numerical solutions
from existing body of knowledge
instead of for the discovery
of analytical solutions
that did not exist,
in the first place.

So, the system of coupled, non-linear,
time-dependent, and state-of-the-art
partial differential equations
of modern calculus,
called the **Philip Emeagwali**'s Equations
are like the **Navier-Stokes** equations
that are posed
in the seven Millennium Problems
that are the seven toughest problems
in mathematics.
The **Philip Emeagwali**'s Equations
are not exactly solvable
on the blackboard.
However, the **Philip Emeagwali**'s Equations
are computably solvable
across motherboards.
That is, the solution
to an initial-boundary value problem
that is defined by the
Philip Emeagwali's Equations
can only be computed
by solving the calculus problem,
or rather by solving

the algebraic approximations
of the **Philip Emeagwali**'s Equations
and executing the arising set
of floating-point arithmetical operations
and executing them **across**
the ten million
six hundred and forty-nine thousand
six hundred [10,649,600], or more,
processors
that define and outline
the fastest supercomputers
of today.

44.4.3 Toughest Problem in Calculus

I've learned new things
about the discoveries that I made
onward of 1974.
I **rediscovered** my discoveries
of the 1970s
by **rewriting** them a few decades later.
As I grew older (and wiser, I hope)

I developed a sharper understanding 2119
of the meanings of the words
“discover” and “invent”
as well as a deeper and surer
understanding
of the meanings of the phrases
“the scientific method”
and “the global network of computers.”
My contributions
to computational mathematics
is this:
I invented
how to solve the toughest problems
arising in mathematics
and I invented
how to solve those problems
in a new way, namely,
how to solve
the most extreme-scaled systems
of equations
arising in algebra and calculus

and how to solve those equations **across** 2120
a new ensemble of processors,
instead of the old way of executing
floating-point arithmetical operations
within only one isolated
processor.
Since the 1940s,
parallel processing was a mystery
that haunted supercomputer scientists.
The January 11, 1946 issue
of the *New York Times*
mentioned parallel processing
as science fiction
and as 100 computers
that could forecast the weather.
I—**Philip Emeagwali**—
was in major U.S. newspapers
for inventing
the massively parallel processing
supercomputer.
My breakthrough invention

were highlighted
in the June 20, 1990 issue
of the *Wall Street Journal*.
My invention
of how to parallel process
to solve the toughest problems
in computational physics
brought a much needed sense of closure
in the development
of the modern computer.
My invention
of the massively parallel processing
supercomputer
is the reason school reports
in the United States
are written about the contributions
of **Philip Emeagwali**
to the development of the computer.
In 1989, I won the highest prize
in the field of supercomputing
and it made the news headlines

2122

that I was the only
supercomputer scientist
to ever win that prize alone.
I won that top prize
for my contributions to the development
of the modern supercomputer.
I won that top prize
because I experimentally discovered
the importance of parallel processing
to the development
of the modern supercomputer.
In 1989,
I won the top prize
in supercomputing
and I won that prize
for my contributions to the development
of the modern supercomputer
and I won that prize
because I experimentally discovered
the role parallel processing plays
in making your computer faster.

2123

I won the top prize
in supercomputing
and I won that prize because
I experimentally discovered
that the impossible-to-solve problems
arising in calculus, algebra, and physics
are, sometimes, possible-to-solve
across millions upon millions
of processors that were already available
in the market anyway.
My invention
of the massively parallel processing
supercomputer
that occurred
on the Fourth of July 1989
became supercomputing's
defining moment
and became the bedrock
of the modern supercomputer
that must process the toughest problems
in parallel.

That invention is my signature invention. 2124