There and back again:
From applied research to academic entrepreneurship

George Papagiannakis
ORMaVR co-founder, CEO
george@oramavr.com
&
Prof. University of Crete,
Affiliated Researcher at FORTH
Visiting Prof. University of Geneva
Overview

• Computational medical XR
• ORamaVR case study
• Academic entrepreneurship?

Midjourney prompt:
“a there and back again hobbit house looking from inside towards outside through the open door, cinematic, atmospheric lighting”
My Career arcs
XR and Spatial computing for medical training?
XR and Spatial computing for education?
People lack access to affordable surgical and anesthesia care according to WHO.

Years outdated medical educational residency model: master - apprentice

Medical professionals' shortage by 20230

People lack access to affordable surgical and anesthesia care according to WHO

*The Anatomy Lesson of Dr. Nicolaes Tulp, 1632, Rembrandt, Mauritshuis museum, The Hague, Netherlands*
Spatial Computing, Medical Metaverse and Digital Twins are revolutionizing healthcare and education

81%²

Of healthcare executives say the metaverse will have a positive impact on their organizations

5B$³

By 2030, the healthcare metaverse market will grow by 48.3% CAGR and be worth $5.37 billion

570%⁴

Reduction in learning time by using immersive medical VR training

Computational medical XR is a new interdisciplinary field, bridging life sciences, with mathematics, engineering and computer science. It unifies computational science (scientific computing) with intelligent extended reality and spatial computing for the medical field.

It integrates computational methods from computer graphics, computational geometry, vision and deep learning to solve hard problems in medicine and neuroscience:

- low-code/no-code authoring
- XR platforms
- XR medical training
- XR surgical planning
- XR operative navigation
- XR for rehabilitation and therapeutics

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Computational Medical XR

Overview

Frontiers SIGGRAPH 2023 talk¹
Frontiers SIGGRAPH 2023 workshop²

¹ https://s2023.siggraph.org/presentation/?id=ftalk_101&sess=sess408
² https://s2023.siggraph.org/presentation/?id=fwork_109&sess=sess287, 2023
Why now for computational medical XR?

“After **years of validation** and **use** by early adopters – XR medical technology is poised to move to the **mainstream**; recent changes in **access** and **cost** make XR quite **affordable**”

*Dr. Walter Greenleaf, Stanford Health Care & Virtual Human Interaction Lab*

“The biggest **challenges** in **healthcare** are (1) **access**—there aren’t enough enough good doctors to provide timely care to all who need it (and clinicians are leaving the field in droves due to burn out), and (2) **cost**—the cost of healthcare has skyrocketed, largely because of increasing labor costs. **AI will solve both** of these issues.”

METAVERSE LOW-CODE AUTHORING FRAMEWORKS

Numerous **authoring frameworks** have emerged to sustain the creation of VR/AR applications.

Main characteristics of virtual reality authoring tools: [1]
- Virtual environment **creation**
- Manipulating and importing **3D** objects
- Interactive **human characters** development
- Artificial intelligence **automation**

"Our medical virtual-worlds (or digital twins) will seem fundamentally different in the future due to the incorporation of developing technology" [3]

"The most evaluated metrics were **usability**, **effectiveness**, **efficiency**, and **satisfaction**." [2]

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METAVERSE AUTHORING FRAMEWORKS: MAGES 4.0

MAGES 4.0 introduces

- Automations in VR design-patterns for interaction-design Actions development
- VR recorder to capture and replay VR sessions
- Realistic real-time cut, tear and drill algorithms
- AR and mobile (iOS/Android) support
- Dissected edge physics engine
- Edge-cloud remote visual rendering
- Optimized networking layer with collaboration of AR/VR devices
- Convolutional neural network automatic assessment
- New template applications (open source)

MAGES 4.0: Accelerating the world's transition to medical VR training
“The scene is set for massive change

What about academic entrepreneurship?
Research & funding

“Buzzwords I know” == latest research strands I have to incorporate in order to get funding
Research & deep-tech

Deep-tech = academic entrepreneurship startup with deeper technology stacks than regular startups

Research I have to follow to get funding

Research I want to do

Deep-tech funded startup
What is academic entrepreneurship and deep-tech startups?

- The process by which university faculties and researchers **convert** their **findings** and **research** into **innovative** marketable **products, services,** or **businesses**
- Deep-tech: “the secret sauce”: algorithm or patent or custom hardware that provides a 12-month **head-start** from anyone else in the field
- Deep-tech: academic startups often have deeper tech foundations than typical startups

Tips:
- Engage with tech-transfer offices early
- Align academic work with market needs (impact)

* Source- Midjourney: “a computer scientist using deep learning algorithms to generate compelling computer graphics solutions to a visualization problem”
Academic Entrepreneurship: “do good” (while making $)

• Fast-growing FORCE in Universities and Research centres:

• Influence technology and business models: "do good" (while making $)

• Growing realization that you can actually set norms and even standards in new ventures for positive social purpose and grand challenges for humanity (health, climate, education), and do this as a FOR-PROFIT (not as NFP)

• Over the 30 social innovation champion students at Stanford GSB, 26 are working on big, social problems and are for profits! (complete flip form 7-10 years ago!)

Steve Ciesinski, Stanford GSB and ex-SRI president
Why academic entrepreneurship deep-tech startups matter?

- Deep-tech startups address global challenges (climate, health, education)
- They create economic growth through innovation, knowledge and jobs
- They create wealth for their founders*, (early) employees and investors
- Startup success (and failure) creates positive spillover effects into more entrepreneurial activity
- Startups’ products and services provide consumers with greater choices
- Enabling countries to build independent critical tech infrastructure: tech sovereignty

Source - Midjourney: “a computer scientist using deep learning algorithms to generate compelling computer graphics solutions to a visualization problem”
Academic entrepreneurship and Academic Research?

• Self-conviction
• Skill
• Luck
• Resilience
• Funding
• Just like academic research!

• Are there differences?

• Scientists: ask the questions to seek answers
• Innovators: take those answers and ideas and turn them to products

* Source - Midjourney: “minimalism 4k pure background two human figures and two 3d spheres”
Regular vs. Deep-tech vs. Biotech startups

Deep Tech and Biotech startups have different paths than regular startups.

**Regular startup**
- Exploit new but proven technologies
- Validate product-market fit as early as possible
- R&D and patent ownership is rare

**Deep Tech startup**
- Starts with extended R&D phase
- Higher share of technical staff
- Often involves hardware and/or IP

**Biotech startup**
- Long and costly testing phases
- Discovery phase becoming shorter*
- Less market risk**

Source: deelroom.co, [https://dealroom.co/uploaded/2023/08/Dealroom-Startup-Demographics.pdf?x92057](https://dealroom.co/uploaded/2023/08/Dealroom-Startup-Demographics.pdf?x92057), 2023
The startup journey can be broken into three stages, with new milestones and performance indicators at each stage.
Idea/Research phase?

- Start with the research question or discovery
- Identify commercial potential
- Form the team
- “Move fast and break things”

Tips
- Not every research outcome has commercial potential
- Regularly assess commercial viability
- Universities can be both a boon and a bottleneck
- Navigating IP rights between researcher and institution early
- Licensing vs. ownership

* Source - Midjourney: “a computer scientist using deep learning algorithms to generate compelling computer graphics solutions to a visualization problem”
Prototyping & Validation?

- Transfer research into a prototype
- Seek feedback from potential users (ideally not your friends as they will be nice to you)
- Refine based on feedback

Tips
- Aim for simplicity and usability in first iterations
- Leverage alumni networks for outreach and support
- Deep-tech requires significant customer education
- Stay flexible and open to feedback
- Most successful deep-tech startups pivot multiple times

* Source - Midjourney: “a computer scientist using deep learning algorithms to generate compelling computer graphics solutions to a visualization problem”
Pre-seed and Seed Funding?

- Pitch to early-stage investors
- Convertible notes or equity investments
- Use funds for further validation and initial growth

Tips
- Refine your pitch and financial projections based on feedback

Source: deelroom.co,
https://dealroom.co/uploaded/2023/08/Dealroom-Startup-Demographics.pdf?x92057, 2023
Series-A and Growth Funding?

- Prove there is a large potential market
- Have some revenue or clear path to revenue
- Use funds for expanding the team, tech-dev and market penetration

Tips

- Refine your growth strategies based on real market data

Mind the gaps!

Source: Crossing the Chasm, J. Moore, Collins, 2014
Startup valuation methods

**DISCOUNTED CASH FLOW VALUATION**

**Venture Capital Method**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projected Year 5 Revenue</td>
<td>$50,000,000</td>
<td>$50 million Based on financial projections</td>
</tr>
<tr>
<td>Price-to-sales ratio</td>
<td>5x</td>
<td>Average valuation multiple for the industry</td>
</tr>
<tr>
<td>Estimated Future Valuation (Year 5)</td>
<td>$250,000,000</td>
<td>Future value of the company at exit</td>
</tr>
<tr>
<td>VC’s Desired ROI</td>
<td>10%</td>
<td>The return VC wants on their investment</td>
</tr>
<tr>
<td>Post-money Valuation Today</td>
<td>$25 million ($25M / 10)</td>
<td>Value of the startup after receiving the VC investment</td>
</tr>
<tr>
<td>VC Investment</td>
<td>$2,000,000</td>
<td>Amount VC plans to invest</td>
</tr>
<tr>
<td>Pre-money Valuation Today</td>
<td>$23,000,000</td>
<td>$23 million ($23M / 2.20) Value of the startup before receiving the VC investment</td>
</tr>
</tbody>
</table>

Back of an envelope calculation to determine if the investment makes sense for a VC:

- They will not believe your revenue projections. They will take 50%
- They will not believe your funding projections and they will double them
- They will take your annualized sales x 8 (if you were acquired or do an IPO this is what you will get for a fast-growing company)
- Divide that by the funding projection to calculate the return on the funds

Source: [https://robojan.gumroad.com/l/StartupValuation](https://robojan.gumroad.com/l/StartupValuation), 2023
Personal Lessons learned from academic entrepreneurship?

• Articulate a clear vision & passion
• Focus R&D efforts on one side, cannot do it in parallel (*academia and startup*)
• Teaching helps identify gaps in your assumptions (as well as hiring)
• Don’t overestimate the presence and underestimate the future
• “we build it and they will come”
• Cultural divides do exist: different language across business, finance, marketing, technical fields
• Motivating and managing your team is one of the hardest things
• Execution is crucial not just the technology!
• Be mindful of which VC you trust for your funding
• Be mindful of your co-founders and first key employees
• Proper accounting & legal support can make or break your startup
• Never run out of cash!

* Source - Midjourney: “*a researcher investigating in a library between thousands of scientific papers and books*”
Some Success stories?

- **TheraPanacea** (https://www.therapanacea.eu). Prof. Nikos Paragios (University of Paris - Saclay), Founder and CEO
- **Rheon Medical** (https://rheonmedical.com), Prof. Nikos Stergiopoulos (EPFL), Founder and CEO
- **Coursera** (www.coursera.com), Prof. Daphne Koller and Prof. Andrew Ng (Stanford University)

Outlook

- The boundaries between academia and deep-tech industry are blurring
- Different universities and research centers have different support mechanisms

* Source - Midjourney: “minimalism 4k pure background human figure walking towards light”*
Is academic entrepreneurship really new?

- Evans & Sutherland company (1968)

The company was founded in 1968 by David C. Evans and Ivan Sutherland, professors in the Computer Science Department at the University of Utah, who were pioneers in computer graphics technology.

They formed the company to produce hardware to run the systems being developed in the University, working from an abandoned barracks on the university grounds. The company was later housed in the University of Utah Research Park.

Most of the employees were active or former students, and included Jim Clark, who started Silicon Graphics, Ed Catmull, co-founder of Pixar, and John Warnock, founder of Adobe.

* Source – computer science museum, Mountain View, California
One more thing

What about no-code generative-AI for medical XR training?
One last thing
In the realm of academic entrepreneurship and deep-tech startups, incredible possibilities await.

Your expertise and passion have the power to transform cutting-edge research into impactful solutions that shape our future.

Embrace the spirit of innovation, embrace collaboration, and pave the way for ground-breaking technologies.

Let us be the catalysts for change, marrying academia with entrepreneurship, and propelling Cyprus to the forefront of the global technological revolution.

Dare to dream big, and make it a reality.
Let’s accelerate world’s transition to academic entrepreneurship!