KURT DUDLEY
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PRINCIPAL SYSTEMS ARCHITECT & R&D DIRECTOR

Cross-Disciplinary Systems Engineering • Hardware–Software–Materials Co-Design • AI Workflows • Zero-to-One Innovation

Inventive Systems Architect and Technical Leader with 13+ years of experience leading multi-disciplinary R&D initiatives spanning mechatronics, embedded control, custom optics, photopolymer chemistry, and AI-accelerated generative pipelines. Holder of **17 granted global patents** cited by Additive Manufacturing industrial leaders: Stratasys, 3D Systems, Formlabs, Carbon 3D, HP, Siemens, GE, and GM. Proven track record of navigating, novel R&D concepts from first-principles modeling through prototype scale-up and commercial viability. Principal Investigator for NSF SBIR awards ($250K) and $2.5M in fund raising for developing advanced manufacturing systems, orchestrating cross-functional teams across mechanical engineering, software, materials.

CORE TECHNICAL COMPETENCIES & LEADERSHIP

- **Systems Architecture & Co-Design:** End-to-end integration of electro-mechanical hardware, high-throughput optical systems (microLED/VCSEL arrays, Multi-projector arrays), liquid thermal management, and synchronized control software.
- **AI & Computational Geometry:** AI-driven generative 3D modeling pipelines, automated toolpath generation, slicing optimization engines, machine learning process control, and digital-to-physical geometric preparation.
- **Physical & Digital Security:** Architect of physical-digital provenance architectures; tokenization, cryptographic model verification, spectral encoding, and chain-of-custody tracking directly embedded into manufactured assets.
- **Cross-Disciplinary Team Leadership:** Translating ambiguous product briefs into deterministic engineering roadmaps; managing agile teams across software, firmware, mechanical design, and chemical engineering; directing academic and defense partnerships.

PROFESSIONAL EXPERIENCE

Advanced Manufacturing & Systems Integration Consultant | 2023 – Present *Principal Systems & AI Integration Architect*
Advises enterprise clients and deep-tech ventures on bridging generative software, materials engineering, and automated physical production.

- **Architected end-to-end AI generative CAD workflows**, integrating 3D model generation tools directly into manufacturing-ready geometry validation pipelines, reducing custom product lead times from days to automated near-instantaneous production runs.
- **Engineered physical-digital provenance frameworks**, implementing cryptographic anti-tamper tracking, digital watermarking, and tokenized authorization models to secure 3D digital supply chains against unauthorized replication and reverse-engineering.
- **Scaled high-throughput material manufacturing**, formulating a proprietary high-performance photopolymer suite that achieved a 70% raw-material cost reduction; designed and deployed a commercial mixing and bottling facility.
- **Pioneered responsive 4D material systems and high-speed SLA architectures**, designing a specialized LED exposure system for biocompatible materials that produced custom orthopedic supports in under 1 hour, cutting out legacy 3D anatomical scanning steps via thermally adaptive polymers.

Orange Maker LLC | 2021 – 2023 *Chief Operating Officer (COO)*
Directed technical strategy, IP monetization, and engineering roadmaps during post-COVID strategic transformation.

- **Re-anchored corporate strategy from pure hardware production to IP licensing and customized R&D services**, establishing profitable technical consulting engagements with enterprise manufacturing and consumer goods partners.
- **Spearheaded hardware-agnostic systems integration**, guiding cross-functional teams to abstract control software and toolpath slicing engines, achieving seamless interoperability across third-party additive manufacturing platforms.
- **Formulated technical feasibility matrices and cost models**, translating high-level enterprise customer requirements into multi-quarter engineering milestones and hardware-material compatibility roadmaps.

Orange Maker LLC | 2012 – 2021 *Founder & Chief Technology Officer (CTO)*
Founded and directed the technical vision, systems engineering, and multi-disciplinary teams developing continuous rotational additive manufacturing architectures.

- **Secured and executed a $250,000 National Science Foundation (NSF) SBIR grant as Principal Investigator**, scaling an unproven 3-inch benchtop concept into an industrial 18-inch by 4-foot continuous production system achieving volumetric throughput of 3–7 layers per second.
- **Architected complex multi-subsystem synchronization**, coupling continuous vertical/rotational mechatronics with localized exposure mechanics and resin replenishment feeds, directly overcoming viscous shear-stress bottlenecks (cited and analyzed in Carbon's US Patent 10,589,512).
- **Led a cross-functional engineering team** spanning precision mechatronics, firmware developers, optical specialists, and organic chemists; raised ~$2.5M in private capital to finance zero-to-one novel 3D printing systems.
- **Invented synchronized high-power optical architectures**, designing and calibrating a custom liquid-cooled 6-projector optical array and dual wavelength photoinhibition 3D printing enabling higher than native DMD resolution features and print speeds exceeding 10 layers per second.
- **Pioneered digital-to-physical cryptographic identity**, creating methods to embed machine-readable spectral and magnetic signatures into structural geometries during fabrication; invited to advise federal stakeholders (including In-Q-Tel) on securing defense supply chains and preventing unauthorized fabrication.
- **Established high-impact interdisciplinary research consortiums**, partnering with Drexel University polymer scientists for composite validation, and co-developing a biocompatible 4-micron micro-fabrication system with Evol Sciences to replace legacy 2D in-vitro cancer research models with 3D cellular matrices.

KEY PATENTS & INTELLECTUAL PROPERTY
(17 total granted global patents; primary inventor across optical architectures, mechanics, material processing, and digital security)

- **US 12,083,744 B2:** Systems and Methods for Additive Manufacturing Security, Encryption, and Part Tracking.
- **US 9,321,215 B2:** Continuous Helical/Rotational Additive Manufacturing Processes and Systems.
- **US 11,141,908 B2 & US 11,958,235 B2:** MircoLED and VCSEL UV Laser arrays for 3D Printing
- **US 9,937,665 B2 & US 10,150,247 B2:** Method for dispensing metal powders for SLA 3D Printing

EDUCATION & CERTIFICATIONS

- **San Diego State University** - Bachelor of Arts, Multimedia - Digital Fabrication (Minor in Marketing)
- **Gnomon School of Visual Effects and Animation** - Advanced 3D Modeling, Digital Assets For Visual Effects
- **Federal Aviation Administration (FAA)** - Private Pilot Certificate