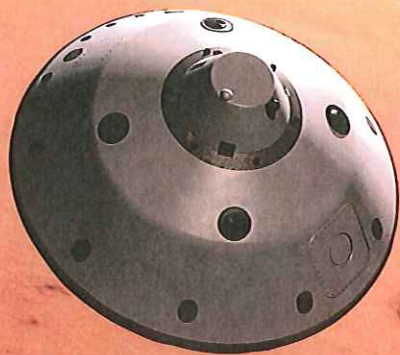


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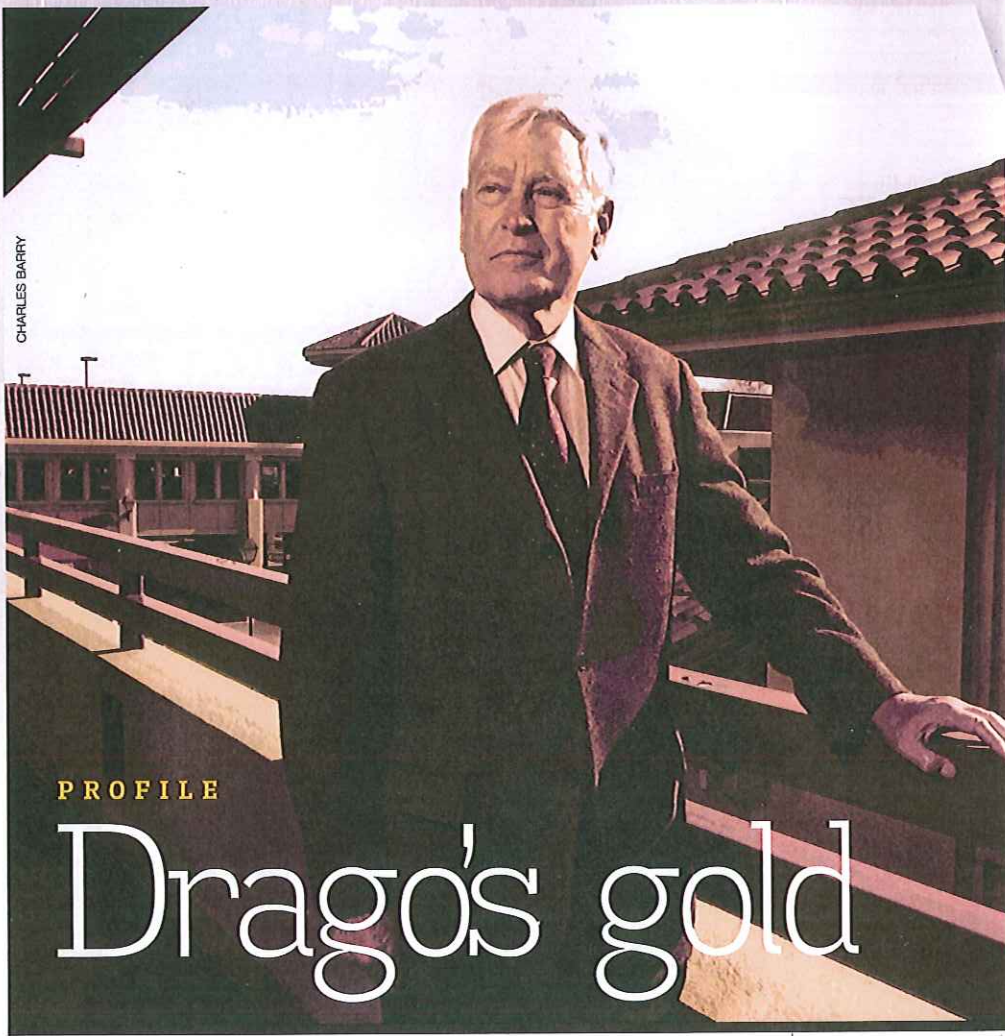
FOR THE ALUMNI AND FRIENDS OF SANTA CLARA UNIVERSITY

MAGAZINE



Where will
SCU engineering
take us next?

CHARLES BARRY



PROFILE

Drago's gold

From an Olympic water polo medal to designing systems for the rocket that put men on the Moon: the life and work of engineering professor Dragoslav Siljak

Dragoslav Siljak should be so lucky to write another book with the staying power of one of his earlier efforts. In 1991, he published a mathematical bible for those trying to understand, control, and predict the kind of vast decentralized systems that increasingly rule modern life—such as electric power systems, communication networks, and mobile robot formations. Two decades later, that landmark guide, *Decentralized Control of Complex Systems*, had fallen out of print, but it still topped Amazon's best-seller lists in two technical categories, with used copies selling for \$800. The title was republished earlier this year.

"I hit the gold mine," says Siljak, the former Benjamin and Mae Swig Professor of Electrical Engineering. He retired from teaching in June. His life's work has been dedicated to bringing control and understanding to highly complex systems, some with thousands of variables. "It's a perpetual topic."

Now as Siljak, the author of four books and hundreds of papers, enters retirement after nearly 50 years at the University, his thoughts have turned to a different kind

of writing—his memoirs for his grandchildren to read. He may not conjure another best-seller, but Siljak—a man with a shock of white hair, square jaw, and a *you've got to hear this* intensity—definitely has tales to tell.

Inside water

Born in Belgrade in 1933, Siljak was just a small boy when Nazi planes began a bombardment that killed thousands in the city and engulfed in flames the apartment house across the street from his family's home. To survive the ensuing occupation, bombings, hunger, and cold, his family often escaped to the countryside to stay with relatives.

The war instilled in him a hatred for the occupying Nazi army that spread death and destruction over his homeland. "Occupation is bad. I remember when my mother and I were taken to be shot by Nazi soldiers for no apparent reason. The people who occupy consider the people they occupy as subhuman, and show no mercy for the

land they occupy."

The end of the war brought a return of normalcy, including regular schooling for virtually the first time in Siljak's life. But the rise of communism in Yugoslavia brought its own problems. His father, like his grandfather, was an ordained Orthodox priest, a stain in the eyes of the new regime. A teacher for the blind, Siljak's father was barred from working with children.

Young Dragoslav, however, found a different path—one writ in water. During his junior year of high school he emerged as a water polo star, a distinction that allowed him to travel and receive much-needed stipends that helped him and his family. In 1952, Siljak—then only 18 years old—made the national team and traveled to the Olympics in Helsinki. There Yugoslavia was undefeated going into the final match against Hungary for the gold. The match ended in a draw; with the winner determined by cumulative goal ratio, the Yugoslav team was awarded the silver. The following year the team won the World Cup in the Netherlands, beating Hungary in the finals, avenging the loss of the gold medal.

For the 1956 Olympics in Melbourne, with the games just weeks after Soviet troops crushed the Hungarian Revolution, Siljak wasn't there for the show. He'd broken his hand in a national championship game and had to stay home. But he was back with the team for the 1960

Olympics in Rome. Alas, Yugoslavia finished fourth—no medal.

Even so, in a country where water polo was king, Siljak appeared set for life: He was all but assured of several more years playing at the top level. But after the 1960 Games, Siljak walked away from the pool for his other passion: mathematics and engineering.

Competitive equilibrium

Siljak had always been as ambitious a student as he was an athlete. At the university, he sought out books by Russian mathematical maestros like Lyapunov, Pontryagin, and Krasovskii. And, in a country where the supply of basic goods and services sometimes made something as simple as putting together multiple copies of an article draft into a monumental task, Siljak managed—as a graduate student at the University of Belgrade—to get papers published in the top U.S. journal in control engineering.

Some 300 people crowded the hall to see him defend his doctoral dissertation, “Control System Synthesis by Conditional Optimization of the Squared Error.” Thousands more read about it in the national newspapers. But brilliance could only get him so far, because Siljak was not a member of the Communist Party.

His published papers, however, caught the attention of U.S. academics, including **G.J. Thaler**, a lecturer at Santa Clara who convinced Dean of Engineering **Robert Parden** to extend an invitation to Siljak. He arrived on the Mission Campus in 1964 to teach and conduct research.

His work on control systems quickly earned him more notice stateside. After hearing Siljak lecture on new control methods for larger booster rockets, an attending NASA scientist invited him to the Marshall Space Center in Alabama, where he soon began work on control design for the Saturn V, the rocket that powered Apollo astronauts to the Moon. The Saturn program was overseen by Wernher von Braun, whose undeniable brilliance couldn't obscure his Nazi past in Siljak's mind.

“His knowledge about rocket engineering, including control, was unbelievable,” Siljak says of von Braun. “But [when] I shook hands with him, it crossed my mind that he shook hands with Hitler. These were mixed emotions.”

Yugoslavia was officially neutral in the Cold War, but the socialist nation was still allied with the Communist bloc. Von Braun told Siljak that he was the only person with a “red” (communist) passport to work on the Saturn V. So if Siljak wanted to use the bathroom, he had to do so with the stall door open and a police officer standing guard.

After having to deal with that once, Siljak says, “On my future visits I decided to make sure I didn't have to go to the bathroom.”



Olympic silver: At Helsinki in 1952

biology to the arms race to gene regulation. That includes a solution to the stability versus complexity problem of model ecosystems, published in the journal *Nature*.

“When we study these models, we don't want to know just what the world is, we want to know what the world can become,” Siljak says.

His ideas brought a stream of scientists and engineers from around the world to Santa Clara to study complex dynamic systems. In 2001,

“We don't want to know just what the world is, we want to know what the world can become!”

he became a life fellow of the Institute of Electrical and Electronics Engineers. In 2010, he published his most recent book, co-authored with colleague **Aleksandar I. Zecevic**, *Control of Complex Systems: Structural Constraints and Uncertainty*. He also

received the Bellman Control Heritage Award, the highest distinction for U.S. control systems engineers and scientists. It was, he told colleagues when he was presented with the award in Baltimore, like winning the gold.

“Drago Siljak is an icon in the field of stability and control,” Engineering Dean **Godfrey Mungal** said after Siljak was named the Bellman winner. “Past winners of the award have come from mostly [large research universities], so it is even more impressive that he has been recognized from an institution which carries a high teaching load.”

Nearing 80, Siljak says retirement is recognition that “teaching is a performing art.” But while he will be spending more time with his four grandchildren, he has no intention of abandoning research on mathematical aspects of multi-agent systems, which remains as fascinating as ever.

“It's why a musician doesn't stop playing music,” he says. “There is this high you get when you're doing it.”

As for the pool, he hasn't fully abandoned that, either. Early evenings this summer, you'd find him in the water at the Sullivan Aquatic Center, swimming laps. Afterward, if you had a few minutes to listen, he had some stories to tell. And he had a few questions. **SCU**

Models and matrices

As the Apollo program ended, Siljak moved on to work on the Large Space Telescope, Skylab, and other NASA projects while broadening his research

into complex systems ranging from population

