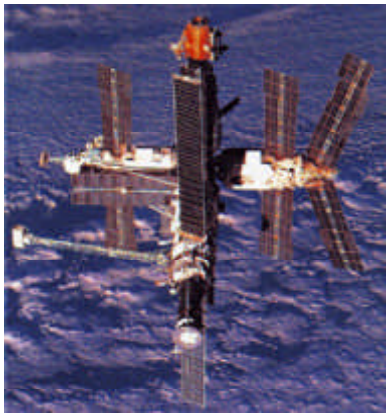
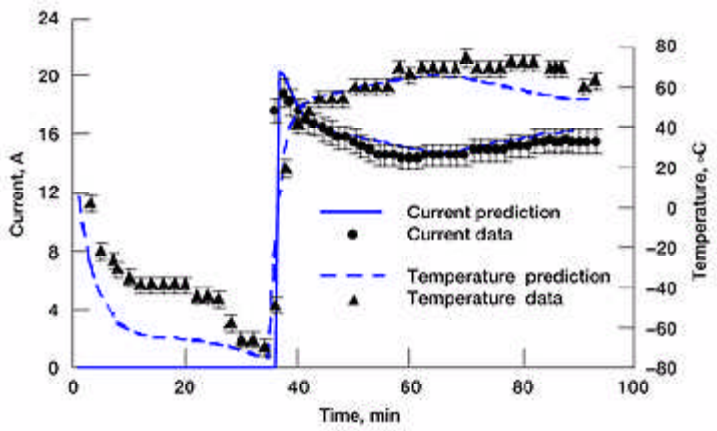
On-Orbit Electrical Performance of a Mir Space Station Photovoltaic Array Predicted



MCSA (foreground) deployed on Mir.

The Mir Cooperative Solar Array (MCSA) was developed jointly by the United States and Russia to provide approximately 6 kW of photovoltaic power to the Russian space station Mir. The MCSA was launched to Mir in November 1995 and installed on the Kvant-1 module in May 1996, where it has been performing well to date. Since the MCSA panels are nearly identical to those of the International Space Station (ISS), MCSA operation offered an opportunity to gather multiyear performance data on this technology prior to its implementation on the ISS. Initial, on-orbit electrical performance and temperature data were measured in June and December of 1996.

To better interpret the MCSA flight data, NASA Lewis Research Center's programmers developed a dedicated FORTRAN computer code to predict the detailed thermal-electrical performance of the MCSA. Computational modeling covers orbit mechanics, vehicle flight attitudes, photovoltaic array pointing, heat transfer, photovoltaic array current-voltage response, environmental degradation, albedo current augmentation, power collection and distribution cabling resistance, and array voltage regulation. This code was a modified version of the premier spacecraft electrical power system analysis code SPACE (System Performance Analysis for Capability Evaluation) developed at NASA Lewis (ref. 1). Predictions from SPACE are used by the ISS Program Office to assess and verify planned ISS operational scenarios.



Generator 6 current and panel 10 temperature predictions versus data for 92-min Mir orbit.

As shown in the graph, the flight data compared very favorably with computational performance predictions (ref. 2). Current predictions matched the data within 5-percent measurement error, and temperature predictions were within 10 °C of measured values during most of the orbital insolation period. This favorable comparison indicated that the MCSA's electrical performance was fully meeting preflight expectations. After 7 months of operation on orbit, there were no measurable indications of unexpected or precipitous MCSA performance degradation due to contamination or other causes. The strong correlation between experimental and computational results further bolsters our confidence in performance codes, such as SPACE, that are used in critical ISS electric power forecasting.

References

1. Hojnicki, J.S., et al.: Space Station Freedom Electrical Performance Model. NASA TM-106395, 1993.

2. Kerslake, T.W.; and Hoffman, D.J.: Mir Cooperative Solar Array Flight Performance Data and Computational Analysis. NASA TM-107502, 1997.

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Programs/Projects: ISS, Mir, MCSA