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Overview of conformal predictors applications in experimental nuclear fusion environments

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Conformal predictors (CP) are a particular case of machine learning methods. Two important characteristics of conformal predictors should be mentioned. On the one hand, a unique hypothesis about the samples is needed: all samples are considered to be independent from each other and identically distributed from the same (but unknown) distribution. No other prior information is required. On the other hand, CP provide estimations of the accuracy and reliability of their predictions not only in classification tasks but also in regression problems. Several applications of CP have shown the potential of the conformal predictors in nuclear fusion:
- Management of high dimensionality problems (102-105 dimensions).
- Real-time predictions.
- Estimation of uncertainty intervals in the determination of transition times in phase transitions.
- Assessment of error bars in non-parametric regression models.
- Determination of outliers in regression problems.
- Automatic increase of the training dataset of classifiers as new predictions are carried out (depending on the accuracy and reliability of the classification).
Applications covering all the above aspects have been developed in the experimental environments of the TJ-II stellarator and the JET tokamak. Results will be presented about (a) the Thomson Scattering diagnostic of the TJ-II fusion device (both real-time and off-line image recognition for automatic data processing), (b) the estimation of uncertainty intervals in the automatic determination of time instants in JET L/H transitions and (c) non-parametric regression models for JET L/H transitions.

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